

STUDY

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# Post Covid-19 value chains: options for reshoring production back to Europe in a globalised economy



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## STUDY

# Post Covid-19 value chains: options for reshoring production back to Europe in a globalised economy

### ABSTRACT

Against the background of supply shortages with respect to medical products during the COVID-19 pandemic, and the shift in the international order towards geopolitical rivalry between the US and China, reshoring of production has become a topical issue in the recent EU policy debate. The study discusses economic and political justifications for reshoring with respect to security of supply concerns and the debate on the EU's strategic autonomy. With reshoring pre-COVID-19 having remained an empirical phenomenon of limited significance, potential for reshoring at the sector and GVC level are assessed in light of recent economic changes, the digital transformation and the changing geopolitical environment. Though reinforced in the recent past, the success of reshoring policies of the US, the UK and Japan is found to have been modest. While a more proactive policy approach to mitigate security of supply concerns and to promote strategic autonomy in the EU is important, reshoring should be primarily focused on specific critical sectors and products with pronounced supply bottlenecks.

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## List of Abbreviations

AMSCI	Advanced Manufacturing Supply Chain Initiative
API	active pharmaceutical ingredient
BPG	benzathine penicillin G
CARES Act	Coronavirus Aid, Relief, and Economic Security Act
CEP	Certificate of Suitability of Monographs of the European Pharmacopoeia
CPTPP	Comprehensive and Progressive Agreement for Trans-Pacific Partnership
CSP	concentrated solar power
EASAC	European Academies' Science Advisory Council
ECJ	European Court of Justice
ECSEL	Electric Components and Systems for European Leadership
EMA	European Medicines Agency
EMS	European Manufacturing Survey
EPC	engineering, procurement and constructions
FDF	finished dosage forms
FDI	foreign direct investment
FFP	Filtering Face Piece
FiT	Germany's feed-in-tariff
FTA	Free Trade Agreements
FY	full year
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GPA	WTO Agreement on Government Procurement
GPT	General-Purpose Technology
GVCs	global value chains
HHI	Herfindahl-Hirschman Index
HMA	Heads of Medicines Agency
HS Code	Harmonised System Codes
HST	Theory of Hegemonic Stability
ICT	Information and Communication Technology
IDMs	Integrated Device Manufacturers
IMF	International Monetary Fund
IoT	Internet of Things
IPCEI	Important Project of Common European Interest
IPE	International Political Economy
IPPs	Independent power producers
IR	International Relations

ISDS	Investor-State Dispute Settlement
KDT JU	Key Digital Technologies Joint Undertaking
KET	Key Enabling Technology
KSM	key starting materials
LDCs	less-developed countries
LEPs	local enterprise partnerships
METI	Japanese Ministry of Economy, Trade and Industry
MGI	McKinsey Global Institute
NAEC	OECD's New Approaches to Economic Challenges group
NAFTA	North American Free Trade Area
NEMs	Non-equity modes
NHS	National Health Service
O & M	Operating & Management
OECD	Organisation for Economic Co-operation and Development
OEM	Original Equipment Manufacturers
PPE	personal protective equipment
PV	photovoltaic
R&D	research and development
ROW	Rest of the World
SMEs	Small and Medium Enterprises
TF AAM	Task force on the Availability of Authorised Medicines for Human and Veterinary
TFEU	Treaty on the Functioning of the European Union
TNC	Transnational Corporation
TPP	Trans-Pacific Partnership
TRIMS	Agreement on Trade Related Investment Measures
UK	The United Kingdom
US	The United States
USMCA	US-Mexico-Canada Agreement
WSTS	World Semiconductor Trade Statistics
WTO	World Trade Organisation

## Executive Summary

Against the **background of both supply shortages due to the COVID-19 pandemic and a secular shift in the international order towards geopolitical rivalry** between the United States (the US) and China, reshoring of production has become a topical issue in the recent EU policy debate. Reshoring refers to the process of bringing productive activities ‘home’ to a specific location, while nearshoring refers to manufacturing being relocated to a country closer to ‘home’. This is motivated both by security of supply concerns and by the need to increase the strategic autonomy of the EU economy in response to the on-going shifts in the international order. The **present study** aims to contribute to this debate by **assessing the pros and cons of employing reshoring as an economic policy tool**. Acknowledging, however, that reshoring does not reflect an independent policy goal in its own right but rather a measure to be assessed in relation to other specific policy goals, this study discusses the role of reshoring with respect to those broader EU objectives concerning (i) the security of supply of critical products, and (ii) (open) strategic autonomy.

Modern international production is organised in global value chains (GVCs), where the stages of production for a final product are located across different regions and different countries, according to the comparative advantages of these locations. Though stagnating over the last decade, **GVC-based production is still vulnerable to exogenous shocks**, for instance caused by pandemics, extreme weather events, political conflict and cyber-attacks. With the **number of such threats likely to rise in the future**, and particularly since the outbreak of COVID-19, the discussion on **GVC resilience**, i.e., their ability to withstand and recover from shocks, **has acquired new urgency**. The discussion has highlighted the **importance of geographical diversification** of production sites and suppliers and emphasised the urgency for lead firms to establish **effective monitoring and due diligence systems** with respect to their supply chains and **to increase stockpiling** to mitigate short-term supply interruptions. However, given the significant investment and operating costs of increasing resilience and the sunk costs of adapting supply chains, companies’ incentives to increase resilience are mixed. Companies might instead prefer to adopt a piecemeal approach, with ultimately limited effects on their security of supply. There is thus a need **to contemplate government policies that promote GVC resilience** including through reshoring, particularly in critical sectors of the economy.

Besides addressing security of supply concerns, reshoring also features prominently in the **discussion on strategic autonomy**. Industrial and technological capabilities and capacities are considered crucial elements for **the international competitiveness of the EU economy vis-à-vis the increasingly geopolitical strategies employed by the US and China**. Such **technological capabilities and capacities are essential elements for successfully tackling grand societal challenges such as the green transition** as outlined in the European Green Deal. **Technological sovereignty in high-tech industries**, and in particular in digital technologies, is increasingly considered a critical element of strategic autonomy, as the competitive position of EU companies is generally regarded as lagging behind that of the US and increasingly also of Chinese competitors. What is more, in their quest for technological supremacy, the latter two countries have recently engaged in ring-fencing key technologies including semiconductors through, amongst other things, reshoring policies. The EU has only just started to react to these developments, arguably with policies that are modest in scope and scale.

The **empirical evidence on reshoring** in the last decade highlights that reshoring processes are on the rise, with larger firms and **medium to high-tech industries exhibiting the greatest reshoring propensity**. However, these processes remain **so far limited in scale** and thus have exerted only small effects on the EU economy as a whole. Effects on employment are particularly low due to the role of automation in driving reshoring processes. The limited effects of reshoring on the EU economy are also related to the fact that reshoring so far has largely been **an intra-EU phenomenon**, even though reshoring

from Asia and China is increasing. The economic **drivers of reshoring are diverse** and are often related to questions of flexibility, quality and the importance of proximity to specific markets/end-users. However, the literature focuses on microeconomic motivations for reshoring, while other factors such as macroeconomic crises or changes in economic policy are often not considered. For this reason, conclusions from the literature for the current COVID-19 situation and the changing geopolitical situation are limited.

Regarding **sectoral potentials for reshoring to the EU**, there is a certain degree of consensus in the literature that **high technology-intensive industries are more likely to backshore to the EU**, due either to economic or political reasons. There seems to be some agreement that economic factors, including automation, increased flexibility and reduced lead times, tend to drive companies in the **machinery, electrical and transportation equipment, and potentially also the electronic sectors** towards reshoring to the EU. Other sectors, such as medical products, chemicals, pharmaceuticals, aerospace, communication, electronics, automotive and semiconductors, tend rather to be reshored for political reasons, such as increased supply security and regional competitiveness, or due to national security concerns. As many of these sectors are heterogeneous and characterised by rather distinct value chains, a closer sector analysis is necessary. To this end, the report presents **four sector case studies on medical products, pharmaceuticals, semiconductors and solar energy** to discuss sector-specific potentials in more detail. The first two case studies are of particular importance in the context of security of supply for critical products, while the latter two are relevant with respect to increasing the EU's (open) strategic autonomy, in particular as relates to the technological sovereignty of the EU and to address grand societal challenges. The case studies highlight that the impact of economic and technological factors upon reshoring will likely remain subdued. Reshoring dynamics will depend heavily on political developments as well as the willingness and ability of policymakers to promote reshoring via targeted policies.

For example, **reshoring in the pharmaceuticals and medical sectors is particularly relevant with regard to intermediate products for generic pharmaceuticals (active pharmaceutical ingredients, APIs) and personal protective equipment (PPE)**, respectively, and less so for on-patent pharmaceuticals or complex medical devices, given large production capacities in the EU. However, reshoring for most of the previously offshored products — many of which may be considered critical products — is unlikely for a variety of reasons. These relate to required economies of scale, complex established regional supplier networks, or higher wages and sustainability standards in the EU. Similarly, the EU is generally not competitive in the semiconductor and solar energy industry, with the exception of certain niche segments such as semiconductors produced for the automotive industry. In the solar energy industry, the EU has the potential to regain some market share in the production of new products (thin-film cells), but **substantial policy support will be needed to see a return of manufacturing**.

The report also presents a review of **reshoring-related policies implemented by three key trading partners of the EU: the US, the United Kingdom (UK) and Japan**. With the exception of Japan, policies that explicitly promote reshoring are rare. Instead, reshoring and nearshoring activities are mainly politically desirable by-products of industrial, trade or other policies that may promote production in or near the domestic market. In the US, the confrontational trade policy of the Trump administration has been a key potential driver of reshoring. In the UK, policymakers focused more on innovation and industrial policies, aiming to support the local manufacturing sector and, as a consequence, also reshoring activities. The Japanese government specifically supports reshoring or nearshoring production capacity in the form of subsidies in its COVID relief program. Overall, we find that while **a few individual success stories of reshoring of major production capacity exist, the overall success of reshoring policies has remained limited**. Large-scale reshoring will depend on strong(er) policy support and the outcome of major geopolitical events such as Brexit and the conflict between the US and China.

With respect to policy recommendations, we argue **that security of supply-related policies need to employ a combination of measures**. These could include in particular: (i) **increasing GVC-resilience**

through obligations on monitoring and due diligence demanded from lead firms; (ii) **stockpiling obligations** for producers and traders of critical products; and (iii) safeguarding and establishing **minimum EU manufacturing capacities for specific critical products**, including through targeted reshoring. Policies to **promote strategic autonomy** will be mostly oriented towards **supporting research and innovation (R&D)** in high-tech and other strategic sectors. They should, however, be complemented by **safeguarding the manufacturing base in the EU**, both through reinforced and harmonised investment screening policies and by **promoting the establishment of manufacturing capacities for newly developed products and technologies**, for example, thin-film solar panels, that are deemed essential for tackling the green transition and other grand societal challenges. Finally, **nearshoring to the EU Eastern and Southern Neighbourhood** could be actively supported by EU Trade Policy.



# 1 Introduction

The COVID-19 pandemic has exposed, among other things, the fragility of global production processes in medical goods and pharmaceuticals. Over the last year, reports on supply shortages for face masks, protective gear and respirators were widespread. Governments and public bodies in the European Union (EU) have been struggling to secure the quantities of these goods required for public health systems to stay operational. World market prices for these goods rose substantially, there were reports of confiscations, deviations to other destinations, or complaints of substandard product quality. While global supply chains have recovered and international sourcing has continued, albeit with difficulties, governments in the EU have also started to organise local production of these goods, either via short-term contracts with private firms or via state-owned enterprises. Setting up local production and meeting the required quantity and quality demands typically takes some time and involves upfront investment that requires financial support by governments. What is more, the discussion on the ramifications of the on-going geopolitical reordering has led to concerns over supply dependencies from other countries that might eventually be misused politically. Concerns with respect to takeovers of EU firms by third-country companies exploiting the crisis situation have led to a major policy initiative by the EU and Member States to reinforce investment screening.

Against this background, the organisation of production has become subject to increasing scrutiny both by policymakers and the general public. Calls for geographically more diversified production chains and for more local production have intensified as security of supply concerns have assumed new importance relative to efficiency and cost considerations. Both the sectoral coverage and the instruments applied to support such a reorganisation of production remain, however, contested. Some commentators go so far as to actively promote across-the-board de-globalisation of production in the aftermath of the COVID-19 crisis, while others argue for a more nuanced approach according to the strategic importance of a sector, involving a mix of policy instruments, including incentivising, stockpiling policies, introducing public procurement standards for companies to diversify their sourcing strategies, and promoting local production, inter alia through the reshoring and nearshoring of offshored/outsourced production. Reshoring refers to the process of bringing productive activities 'home' to a specific location (Kinkel and Maloca, 2009). A further distinction can be made between backshoring and nearshoring. Backshoring occurs when manufacturing activities return to their initial country of origin, while nearshoring refers to manufacturing being relocated to a country closer to 'home' (see section 3.1. for an in-depth discussion).

The present study aims to contribute to this debate by offering a systematic analysis of the issues at stake with respect to reshoring. It is important to state at the outset that reshoring as such should not be a policy goal for the EU but rather a means that may be instrumental to achieve existing policy objectives. In this study, we will assess the potential contribution of reshoring to two overarching EU policy goals: (i) to improve the security of supply for certain critical goods, and (ii) to increase the (open) strategic autonomy of the EU. However, since reshoring policies arguably involve trade-offs, we extend our discussion, where necessary, to other available policy instruments, thereby ensuring that key issues are addressed openly and sufficiently.

To this end, section 2 starts by assessing trends and drivers in the transformation of global production processes, discussing the significance of (i) the slowdown of globalisation ('slowbalisation') and the trend towards more regional production networks; (ii) supply chain vulnerabilities due to both man-made and natural crises; (iii) the shift in the international order towards great power rivalry as exemplified by the United States (the US) and China; and (iv) the digital transformation and its impact on regionalisation and localisation. Section 3 assesses the conceptual discussion. It starts by introducing various reshoring concepts, before going on to address the on-going debate on global value chain (GVC) resilience, and the debate on the (open) strategic autonomy of the EU, and to discuss the respective role of reshoring in these

debates. Section 4 presents a review of the empirical evidence on reshoring and discusses reshoring potential, firstly discussing the empirical evidence on reshoring processes pre-COVID-19 before going on to analyse the potential for reshoring on a sectoral basis. After providing an overview on reshoring potential across sectors, we provide in-depth analyses of four sectors of strategic interest. The first two of these — pharmaceuticals and medical products — are relevant under security of supply concerns, while the other two sectors — semiconductors and solar energy — are important under strategic autonomy and technological sovereignty considerations. Section 5 provides a comparative analysis of the reshoring policies of three partner countries of the EU, namely the US, the United Kingdom (the UK) and Japan. Our key conclusions and policy recommendations are set out in section 6.

## 2 Trends and drivers in the transformation of global production processes<sup>1</sup>

In this section, we will highlight ongoing trends in global production processes and attempt to identify drivers of change for the spatial configuration of production. Firstly, we discuss the development of global production processes since the early 1980s and the recent trend towards slower global economic integration ('slowbalisation') and a more regionalised trajectory of production networks. Against this backdrop, we will then move on to focus on recent developments that have been broadly identified as triggering potentially far-reaching consequences upon the global economy, including (i) the increasing vulnerability of global production networks to emergencies, both man-made and natural, (ii) the erosion of the liberal international order and the shift towards great power rivalry, and finally (iii) the digital transformation. A final synthesis assesses the expected impact of each of these factors.

### 2.1 Slowbalisation and the trend towards more regionalised production structures

The production processes in most goods and services sectors and the financial, legal and administrative activities relative to them have undergone profound transformations over recent decades. These processes are increasingly fragmented and dispersed across various actors and geographic spaces, thus creating complex sequential chains and networks. Prominent examples include GVCs in textiles and apparel, electronic goods, automobiles, and processed foods (Ponte, Gereffi, and Raj-Reichert, 2019).

The establishment of such GVCs has been an essential part of the process of 'hyper-globalisation' over the last four decades, with its drastic changes in the size, structure, and velocity of trade and capital flows (Rodrik, 2011). Enabling economic factors for this development have included, on the one side, advances and innovations in logistics (containerisation, just-in-time delivery) and information and communication technology (ICT), all of which have contributed to cutting transaction costs. On the other side, political factors such as the establishment of the World Trade Organisation (WTO) as the centre of the multilateral trading system, the proliferation of bilateral investment agreements and active government policies for attracting foreign direct investment (FDI) have been instrumental for the transformations in trade patterns and the organisation of global production. The number of bilateral trade agreements and other forms of economic treaties on investment and taxation rose exponentially after 1990 and resulted in tariff cuts and the lowering of trade barriers, even once WTO negotiations started to stagnate in the early 2000s. The EU's focus on negotiating bilateral 'deep and comprehensive' Free Trade Agreements (FTA) has expanded the scope of trade policy to a broad range of topics that aim to align regulations in partner countries to international and EU standards.

As a consequence of the liberalisation of cross-border economic activity, transnational corporations (TNCs), which are headquartered mostly in Organisation for Economic Co-operation and Development (OECD) countries, found themselves in a privileged position to reorganise the structure of world production, coordinate complex processes across long distances, and expand cost-minimising strategies on a global scale (UNCTAD, 2018). It is estimated that TNCs, acting as lead firms in GVCs, directly and indirectly, coordinate 80% of global trade, with the resulting cross-border movement of intermediate goods and inputs leading to strong growth in global trade (UNCTAD, 2013, 2018). Trade data reflect these developments. Firstly, the value of global trade has expanded by a factor of ten, from USD 2 trillion in 1980 to almost USD 20 trillion in 2018 (World Bank, 2020), equivalent to a compound annual growth rate of more than 6%. Secondly, one-third of global exports now originate from countries in the East Asia & Pacific

<sup>1</sup> The section is partly based on Raza et al. (2021)

region, particularly from China, compared to 18 % in the 1980s (UN Comtrade, 2020). Thirdly, intermediate products represent almost half of the world trade in goods today, having doubled from USD 4 trillion in 2005 to more than USD 8 trillion in 2018 (UNCTAD, 2020a).

However, the acceleration of global trade has not translated into output growth rates to the same degree as in the 'golden age' of the 1950s to 1970s, given the increased exchange of intermediate goods and the shift in the broad macroeconomic policy framework (UNCTAD, 2018). The relocation of production activities and the consequent imports from low-wage countries have reduced manufacturing employment in many OECD economies (see for instance Autor, Dorn and Hanson, 2013 for the US; Mion and Zhu, 2013 for Belgium; Malgouyres, 2017, for France; Thewissen and van Vliet, 2019 for OECD countries). It is associated with lower wages, rising inequality, and, according to a growing body of literature, also to political polarisation (Autor et al., 2016; Che et al., 2016).<sup>2</sup> Further, the growing dominance of TNCs and their cost-minimising strategies also affects global functional income inequality as the rapid growth of profits of top TNCs pushes down the global income share of labour (Kohler and Cripps, 2018; UNCTAD, 2018).

During the 'golden age' of globalization from 1980 to 2007, trade in manufactured goods soared, propelled by China's entry into the WTO and the search by multinational companies for lower-cost inputs and lower labour costs. Digital communication resulted in lower transaction costs, enabling companies to do business with suppliers and customers around the world. Overall, up until the year 2000, trade in goods grew at roughly twice the rate of global Gross Domestic Product (GDP) growth over the same period (see Figure 1).

However, these trends were interrupted by the 2007/2008 global financial crisis, causing global trade and FDI flows to plummet. While the global economy eventually recovered, it never returned to its former growth trajectory. Besides a weak economic recovery after the global financial crisis, particularly in Europe, the decrease in global trade may also be ascribed to China and other emerging economies reaching the next stage of their development. Initially participating in GVCs exclusively as assemblers of final goods, emerging economies increasingly became the world's major engine of demand growth and started to develop more extensive domestic supply chains, thus decreasing their reliance on imported inputs. As a result of these developments, a smaller share of the goods produced worldwide has since been sold across borders. Thus, given the available empirical data, the globalisation of production via GVCs had already peaked prior to the global financial and economic crisis (see Figure 1).

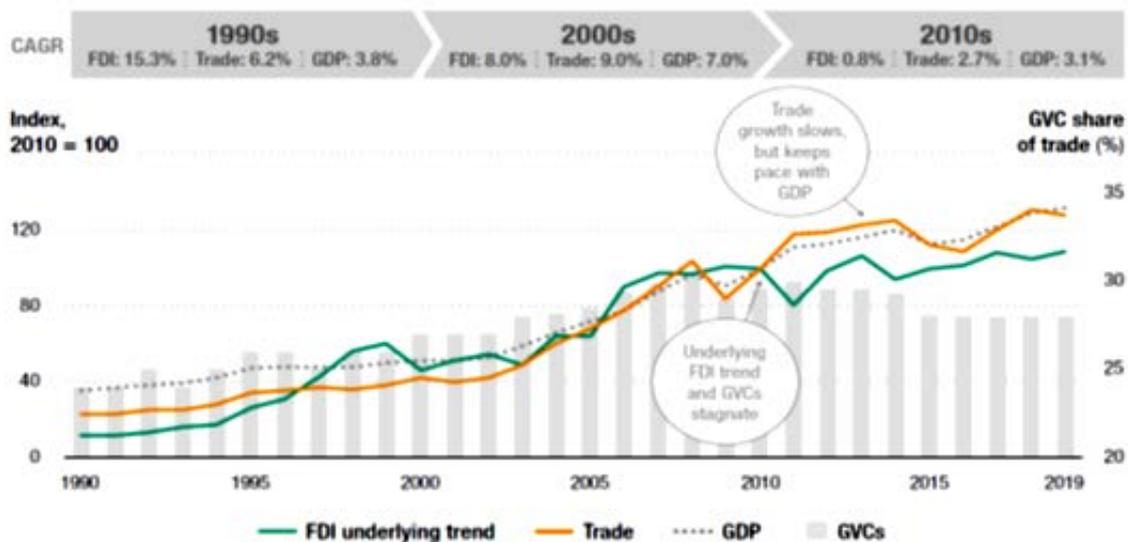
Following the global financial crisis, and particularly after 2010, the growth momentum of international production thus stalled. This was first reflected in trade, whereby worldwide exports of goods and services slowed down significantly relative to economic growth. UNCTAD (2020b) argues that FDI followed the same trend, although the expanding financial component of FDI temporarily obscured this fact. The causes of the stagnation in investments are attributable to international operations of TNCs becoming more intangible and less dependent on investment in physical assets. Non-equity modes (NEMs) of international engagement such as outsourcing, licensing, etc. became firmly established as a third operating mechanism in international production, beside arm's-length trade and FDI. NEMs allowed TNCs to access overseas markets through contracts rather than FDI, while still exercising a significant degree of control over operations. Technology TNCs also became increasingly important, as these firms can reach markets worldwide through digital channels and without the need for a significant physical presence. In contrast, manufacturing investment declined: according to UNCTAD (2020b), the value of greenfield cross-border

<sup>2</sup> Amongst others, Antràs (2020) argues that populist politics due to widening wealth and income inequalities will also be a crucial political factor contributing to the trend towards globalisation and, arguably, de-globalization in the future. Though topical, the issue of populism, including the controversial debate on whether its root causes relate to economic or cultural factors (see Rodrik, 2018; Inglehart and Norris, 2016), will not be systematically addressed in this report, as it transcends the scope of this study.

investment projects in manufacturing industries was structurally lower (by 20 % to 25 %) than in the previous decade, even in Asia, the only region still showing significant growth in overall FDI inflows.

This new normal of slow growth in world trade and cross-border investment flows has been dubbed ‘slowbalisation’ by *The Economist magazine*. Another feature of the age of slowbalisation refers to the trend of trade and production networks towards becoming more regionalised. Since the early 2010s, the share of intra-regional trade in goods has increased by close to 4 percentage points (see Figure 2). Against this background, it is important to note that the COVID-19 crisis thus coincides with a pre-existing trend towards more regionalised economies. Arguably, COVID-19 will contribute to this trend by giving an impetus to pending reshoring and nearshoring decisions by companies (Barbieri et al., 2020).

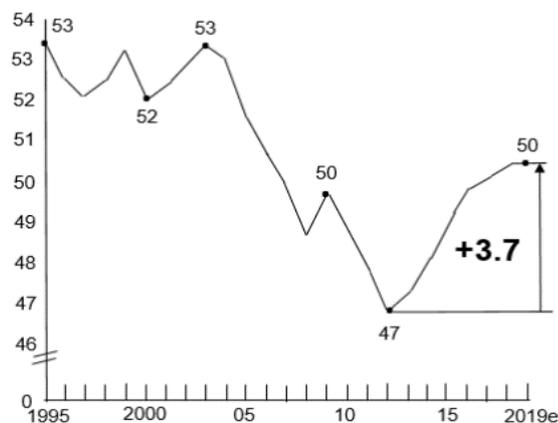
**Figure 1:** FDI, trade, GDP and GVC trends, 1990–2019



Source: UNCTAD, 2020b, p. 5

Note: GVC-related trade is measured by the share of imported intermediate goods on exports. FDI, trade and GDP indexed, 2010=100; GVCs, per cent

**Figure 2:** Share of intra-regional goods trade in total trade



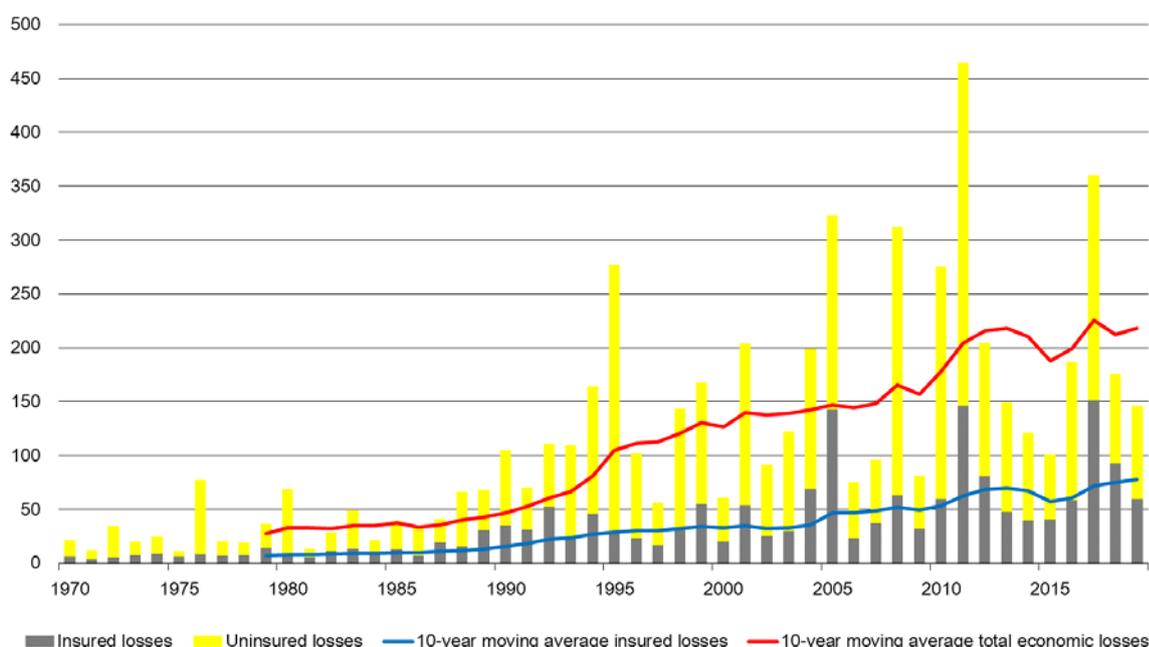
Source: MGI, 2020, p. 44

## 2.2 The growing vulnerability of global value chains

While Europe is still experiencing the effects of the COVID-19 pandemic, it is worth noting this is not the first shock or crisis to have raised cause for concern in recent times. Indeed, research has concluded that the frequency of shocks, due in particular to extreme weather events, has increased over the past 50 years. According to data published by the European Academies’ Science Advisory Council (EASAC), the number of floods and other hydrological events has quadrupled since 1980 and doubled since just 2004. Climatological events, such as extreme temperatures, droughts, and forest fires, have more than doubled since 1980. Meteorological events, such as storms, have doubled since 1980 (EASAC, 2018). As world temperatures rise, the frequency of and losses resulting from severe weather events will likely continue to increase (Swiss Re Institute, 2020).

Extreme weather events carry substantial economic costs. According to the Swiss Re Institute (2020), the average annual economic loss attributable to weather-related events has grown sixfold from approximately USD 30 billion in 1980 to more than USD 200 billion in 2019. The study estimates economic growth and urbanisation to account for a 55 % share of the increase in economic losses over the period. The same methodology applied to emerging economies shows that economic growth and urbanisation are the driving force behind at least 70 % of the 8 % annual increase in economic losses from weather-related events over the same period.

**Figure 3:** Economic loss from catastrophic weather events, 1970–2019, in billion USD

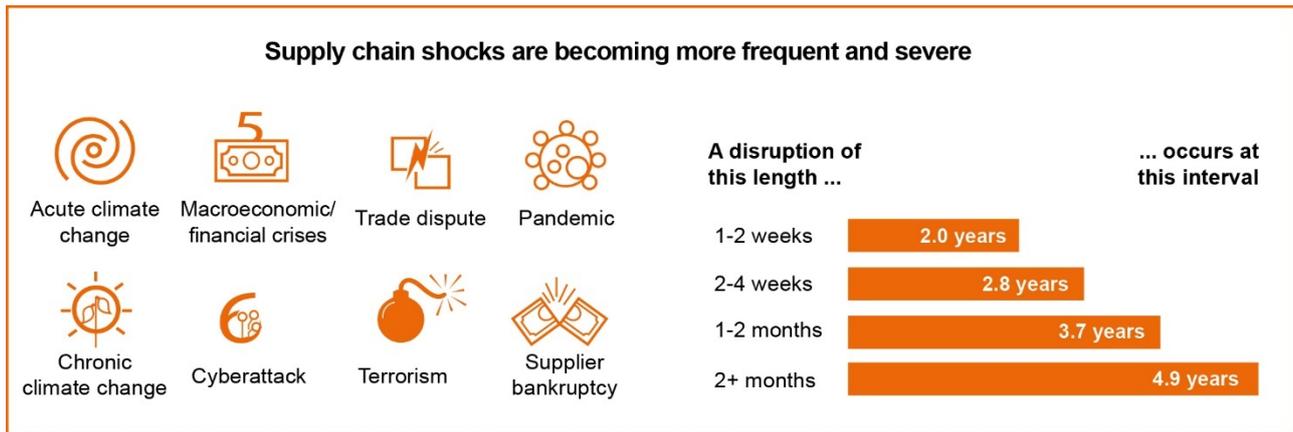


Source: Swiss Re Institute, 2020

However, companies and their value chains are not only exposed to natural disasters, but also to different kinds of man-made shocks. As the international system moves towards a multipolar order, trade disputes are on the rise, with tariffs increasing. The share of global trade conducted with countries ranked in the bottom half of the world for political stability, as assessed by the World Bank, rose from 16 % in 2000 to 29 % in 2018. Increased reliance on digital systems increases exposure to a wide variety of cyberattacks: the number of new ransomware variations alone doubled from 2018 to 2019. Interconnected supply chains and global flows of data, finance, and people offer more ‘surface area’ for risk to penetrate, and ripple

effects can travel rapidly across these network structures (MGI, 2020). Figure 4 provides an overview of the different types of shocks and their frequency.

**Figure 4:** Types of shocks to GVCs and their frequency



Source: own elaboration based on MGI, 2020

According to estimates by the McKinsey Global Institute (MGI) based on expert interviews, a shock with a duration of 1-2 months currently occurs every 3.7 years. MGI believes that companies can expect to lose on average more than 40 % of a year's profits every decade. A single severe event that disrupts production for 100 days — something that usually happens every five to seven years — could cost some industries almost a year's earnings. Although given the methodological problems typically associated with such estimates, these numbers should be interpreted with great caution, the widely shared views amongst scientists about the increasing economic losses to be expected from extreme weather events and the other risk factors listed above do suggest that an increase in the number and length of supply chain disruptions is likely.

Value chains are exposed to different types of shocks based on their geographic footprint, factors of production, and other variables. Those GVCs with high trade intensities (imported inputs and exports as a share of added value) and with exports concentrated across only a few countries are particularly exposed to shocks. The industries most affected include those in the high-tech sector, such as communication equipment, computers and electronics, and semiconductors and components. Many labour-intensive GVCs, such as apparel, are particularly exposed to pandemics, heat stress, and flood risk. In contrast, food and beverages and fabricated metals have lower average exposure to shocks because they are among the least traded and most regionally oriented value chains. For pharmaceuticals and medical devices, given their high trade intensity, exposure does not only relate to the risks associated with a pandemic but also to trade disputes.

Geographic concentration in supply networks can also present a vulnerability. On a sectoral level, concentration of production since 2000 has been particularly pronounced for mobile and communication equipment, computers, and labour-intensive industries such as textiles and apparel and furniture. Even in value chains that are generally more geographically diversified, production of certain key products may be disproportionately concentrated. Export concentrations for products can be measured by the Herfindahl-Hirschman Index (HHI). On the basis of this indicator, MGI (2020) identifies 180 products across value chains (worth USD 134 billion in 2018), for which one country accounts for 70 % or more of exports, creating the potential for bottlenecks. For instance, many low-value or basic ingredients (active pharmaceutical ingredients, APIs) in pharmaceuticals are produced predominantly in China and India. The chemicals sector has a particularly large number of such highly concentrated products, but other examples can be found in multiple industries, including in food and beverages, and apparel. Other products may be produced across

geographically diverse areas but have severe capacity constraints, creating bottlenecks in the event of production stoppages. Similarly, some products may be exported by numerous countries, but trade takes place within clusters of countries rather than on a global basis. In those instances, importers may struggle to find alternatives when their primary supplier experiences a major disruption.

Economic theory has only recently started to analyse the relationship between trade openness and exogenous shocks; Caselli et al. (2015) analyse whether the prevailing assumption that economic specialisation and openness to trade lead to higher macroeconomic volatility is correct. They show that sector-specific shocks, i.e., shocks that hit a specific sector in a country or region, lead to increased macroeconomic volatility. These shocks are, however, less frequent in number than country/region-specific shocks, which affect all sectors in a particular country or region. Such shocks have less severe economic impacts if the country is open to international trade and has diversified supply relations with other countries at its disposal throughout the crisis. In the event of local shocks, for example, extreme weather events such as storms, floods, droughts and heatwaves, international trade and diversified supply chains are conducive to security of supply. Of course, the shock delivered by COVID-19 was highly systemic, hitting all countries and all sectors of the economy. In this case regionally diversified GVCs do not necessarily bring added value, as damage to production occurs across many countries simultaneously. Here, the nature of the correlation between countries/regions is of particular importance. If an epidemic spreads, as was the case with COVID-19, from lower-income countries engaged in the low-value production stages of a GVC into countries with the higher value-added stages, for example, in Europe and the US, the normal functioning of the GVC risks a lengthy hiatus, as the interruptions caused by the crisis ripple all the way through the various distinct stages of the GVC (Egger, 2020). Similarly, where a particular country or region is an important production hub for certain products sourced by companies from many other countries, as is the case for APIs in China, the economic effects of this single country being hit by an external shock may be felt internationally.

By way of summary, the frequency of natural or man-made shocks to GVCs will likely increase in the future. The existence of GVCs as such increases the likelihood that such shocks are transmitted to other regions, leading to the subsequent increase in macroeconomic volatility. Geographically diversified production structures contribute to the resilience of economies during crises if supply interruptions in one country can be replaced by imports from other countries. A pronounced geographical concentration of global production of certain goods may exacerbate economic vulnerabilities if that particular region is affected by a crisis. Regional and global diversification of production will thus be beneficial in mitigating the impact of shocks on production organised in GVCs, although the true effects will very much depend on the nature of the shock involved, that is, whether the shock is regional or global/systemic in nature.

## 2.3 The crisis of the liberal international order and the renaissance of geopolitics

The discussion on the importance of the international division of labour, or, more generally, on the spatial organisation of production is not new but can be traced back throughout the history of economic ideas. Liberal economic doctrine has consistently argued that decisions on the place of production should be left exclusively to market actors and ought to be based on considerations of efficiency, thus maximizing the gains from the (international) division of labour (Slobodian, 2018). Countries should thus reduce tariffs and other barriers to trade. As a consequence, countries would be able to specialise in the production of those goods where they held comparative advantages. What has developed since the 1970s is indeed an international division of labour, where the industrialised countries of the core have moved into higher-value, capital-intensive and technologically advanced production (and into services) while closing down and offshoring 'old industries' to third countries. The emerging and developing world's trajectory has differed. Emerging economies, particularly in East Asia, but also Turkey and Central America, expanded first

into the production of lower value, labour-intensive consumer goods (e.g., apparel, shoes, consumer electronics etc.), and only more recently also into mid and high-tech goods and services. A number of less-developed countries (LDCs), particularly in Africa, South America and Central Asia, have experienced de-industrialisation and a re-orientation towards the extraction of raw materials and agricultural commodities.

The structural change brought about by the international division of labour under hyper-globalisation arguably resulted in large efficiency gains, but also entailed a variety of trade-offs, which have been long side-lined by academia and policymakers alike. The social implications of international trade, in particular its impact on the distribution of income and on employment, have been the topic of a controversial discussion for the last 20 years or so. In the empirical literature, a broad consensus has now been reached that globalisation has resulted in the loss of industrial employment in the core countries and that this has had a significant impact on the distribution of income (Autor, Dorn and Hanson, 2013; Milanović, 2016). Another issue that has only recently received some attention, although the problem has been dealt with extensively in the development economics literature under the rubric of 'balance-of-payments constrained growth', deals with the implications of unbalanced patterns of trade for macroeconomic stability (Thirlwall, 2013; Podkaminer, 2016). A third issue, long ignored in the mainstream debate but now brought to the surface by the climate crisis, concerns the environmental costs of highly fragmented global GVCs and just-in-time production models, which are typically not factored into the prices of these products, and thus result in market prices not reflecting the full social costs of production.

In contrast, what the COVID-19 crisis has helped to reveal are the threats of GVCs to national security and the security of supply, particularly during times of crisis. An enduring argument of other schools of thought such as Keynesian public finance (Musgrave, 1959; Stiglitz, 2000) in economics, but in particular International Relations (IR) theory, has been that locational decisions always involve trade-offs between economic efficiency and other legitimate concerns, which are either (i) economic in nature, e.g., macroeconomic stability, dynamic efficiency and technological development concerns such as late industrialisation policies in LDCs etc., or (ii) non-economic motivations, such as distributive justice, environmental sustainability, national security, or security of supply. All of these concerns, whether economic or non-economic, have an effect on the resulting international economic and political order.

The literature on GVCs typically departs from the assumption that the international division of labour and its forms of governance are ultimately driven by the interests and decisions of economic actors, most notably TNCs. It is thus the motivations and decisions of companies that are at the centre of the analytical focus. The decisions of these firms, themselves regarded as increasingly transnationalised actors and detached from nation-states, are conceived of as being driven mainly by economic imperatives; on the other hand, the state and national governments, whose role is that of setting a regulatory framework that facilitates international trade and investment, is seen as largely accommodative. With the support of TNCs and other non-state actors, governments would actively support the construction of a set of international institutions that provided a regulatory framework for a liberal international order characterised by the free flow of goods, services and capital. This was precisely the central idea behind the neoliberal discourse on globalisation (see Slobodian, 2018). The more progressive version of the global governance discourse emphasised the importance of promoting human rights and democratic participation (see, e.g., Archibugi and Held, 1995). Multilateralism has been experiencing a crisis of legitimacy. Over the last two decades, the liberal international order, well established until the year 2000 or so, has begun to show signs of erosion. This is highlighted by the marginalisation of the WTO, the rise of bilateralism in trade policy, and, more recently, the outbreak of the 'trade war' between the US and China. A more general move towards protectionist policies, which has gained strong momentum with the Trump administration, but clearly precedes it, is further testament to the ongoing change in international relations. This is a change that liberal internationalism and concepts of global governance have great difficulty in explaining.

Other schools of thought do provide some guidance on the changes underway in the international system; this is particularly true for IR literature. While distinct theoretical traditions co-exist in the field of IR, influential approaches in the Realist tradition emphasise the primacy of the political, i.e., the dominant role of (large) nation-states, in determining the structure of international trade (Krasner, 2009). In contrast approaches in the tradition of critical International Political Economy (IPE), though sharing the ultimate primacy of the political in determining economic issues, have a more nuanced understanding of the mutually constitutive relationship between the economic and the political, as well as of the role of non-state actors (Overbeek, 2013; Gill, 2014).

In contrast to liberal economic doctrine, the Theory of Hegemonic Stability (HST), a product of different theoretical traditions in IR, including Realism and the systemic school, has observed that free trade has not been the norm throughout the history of capitalism (Kindleberger, 1973). HST declines the primacy of economic actors in determining the structure of international trade but posits that the structure is ultimately determined by state power (see Krasner, 1976; Hirschman, 1945). States are thought of as largely independent actors, their actions being directed towards increasing power in the international system (Krasner, 2009). States use a variety of measures including trade policy to foster their power in an international system of asymmetrical interdependence, in which all states are linked by trade relations, but larger states typically are less dependent on trade for their economic well-being than small states. An open international trading system thus depends on the extent to which large states can promote their main strategic interests via the pursuit of trade policies. These interests are focused on promoting economic income and growth, social stability, national security, and technological and financial dominance, amongst other things. While small states tend to favour an open system of trade, given their limited domestic market, such a system will emerge only if it is actively supported by large states, and, above all, by a hegemonic state, i.e., an economically and politically dominant power.

What is more, an open international trading system may not be stable in the long term, but will eventually be undermined, for example, by 'security externalities'; trade may have positive impacts on the military potential of other large economies as dynamic efficiency gains allow countries to upgrade both their technological and thus also their military capabilities (Gowa, 1994). Thus the dominant position of the hegemon is eventually undermined by the ascendancy of other states, eroding the incumbent's support for open multilateral trade. As a consequence, economic poles will emerge, composed of a large state with its allies tied to it by a system of bilateral/regional arrangements. The poles serve both military-strategic as well as economic interests. The leading state will promote the regionalisation of GVCs and support the establishment of more integrated supply chains amongst the countries affiliated to its zone of influence, including through strategies of nearshoring. Recent projects such as China's Belt and Road Initiative (BRI) as well as the United States-Mexico-Canada Agreement (USMCA) and the new Western Hemisphere Strategic Framework of the US with respect to Latin America are clearly motivated by this logic.<sup>3</sup>

In the geopolitical age, trade is thus closely connected to national security, as exports of advanced technology threaten to eventually undermine the technological superiority of the hegemon. It is widely acknowledged in IR theories that the political power of states is closely related to its economic and technological capacities, which together with its financial power, form the backbone of its military strength (see Strange, 1988). Against this background, the 'trade war' launched by the Trump administration against China must be interpreted as an effort to maintain the technological and thus, ultimately, the military superiority of the US. In this undertaking, trade policy is explicitly put to the service of national security

The reassertion of large nation-states as key actors on the international stage, including both major global powers such as the US and China, but also second-tier regional powers such as Russia, India, Turkey, Iran,

<sup>3</sup> For more info see <https://geopoliticalfutures.com/washingtons-new-economic-strategy-in-latin-america/>; and <https://www.csis.org/analysis/nearshoring-americas> (15.02.2021)

Indonesia, and Brazil, amongst others, has been underlined by the recent ascendancy of looser forms of international cooperation such as the G-20, functioning outside of institutionalised international governance mechanisms such as the International Monetary Fund (IMF) or the WTO. Last but not least, crisis phenomena like the global financial crisis of 2007/2008 and more recently, the COVID-19 pandemic, have reinvigorated the role of national governments as crisis managers. Given their monopoly (i) on the legitimate use of force, (ii) on the issuance of legal tender, and (iii) on taxation, national governments are the ultimate security mechanism, both for safeguarding economic development and social reproduction during times of crisis. So far the EU is the only partial exception to this general rule.

By way of summary, the renaissance of geopolitics is thus a consequence of the contradictions that have evolved within the liberal international order over the last four decades. Most notably this includes financial exuberance as demonstrated by the global financial crisis, the social costs of trade, as evidenced by growing inequality in the OECD world, and unemployment due to the relocation of production. The open liberal order has also contributed to shifts in economic and technological capacities and capabilities. This has progressed to such an extent that the US, as the incumbent hegemonic power, considers it as a threat to national security. All of these factors have eroded trust in international institutions and forms of global governance and have led to the re-emergence of nation-states as primary actors in international politics, while the legal form of government has significantly shifted in the direction of populism and authoritarianism.

The direction of the geopolitical reordering of the international system currently underway is, however, not a given. Ultimately it is politics that determines the course of action. Although state power continues to be an important force in international politics as posited by Realist IR, the critical IPE literature points to the importance of the interplay of political, economic, and social forces at different territorial levels in determining the resulting politics. Whether state power will thus be employed to pursue a Machiavellian understanding of hard power or a more cooperative form of international politics is not pre-determined but will result from the relative balance of social forces and their respective influence on the actions of states. It is evident that the ongoing changes will exert pressure on the EU to reconsider its external economic policy setup. In this reset, a variety of factors will have to be considered. In addition to the distributive impacts of globalisation and the threats emanating from public health crises such as COVID-19 on the security of supply for essential products, the ongoing geopolitical reordering will arguably exert a major impact on the future direction of in particular the EU's trade and investment policies. Given the efforts of both the US and China to build economic poles with more regionally integrated supply chains, the EU will have to assess the extent to which it wishes to promote more regionalized production models.

## 2.4 Digitalisation and its impact on production

Apart from geopolitical reordering, a second secular trend currently underway is digitalisation. From an economic point of view, digitalisation holds a number of promises, e.g., with respect to productivity growth. The impact of digitalisation on the spatial configuration of production has received growing attention in recent discussions, both at the academic and policy levels. Before providing a review of this discussion, we will start by giving a brief overview of the contents of the empirical literature regarding the relationship between digitalisation and reshoring.

Firstly empirical assessments on the relationship between reshoring and Industry 4.0 were presented by Ancarani and Di Mauro (2018), Dachs, Kinkel and Jäger (2019) and Kinkel (2020). Based on an assessment of 840 reshoring initiatives (mostly in the US and Europe), Ancarani and Di Mauro (2018) conclude that robotisation is generally not a key driver of reshoring processes, but plays a more important role when reshoring is linked to design and product innovations. In an econometric analysis of the European Manufacturing Survey (EMS) 2015 dataset (1 700 manufacturing firms from Austria, Germany, and Switzerland), Dachs, Kinkel and Jäger (2019) find a positive and significant relationship between the

reshoring of production activities and investments in Industry 4.0 technologies. Based on the EMS 2015 dataset, Kinkel (2020) confirms these findings in his analysis of 1 300 German manufacturing firms, underlining the significant positive correlation between the use of digitalisation technologies in manufacturing and reshoring.

Judging from the results of the still rather limited empirical literature, the effects of digital technologies on the spatial configuration of production are modest and dependent on the type of technology as well as on the type of industry. Furthermore, the economic effects might differ significantly: while, for instance, communication technologies such as 5G, cloud computing, and artificial intelligence will arguably promote the growth of GVCs as well as facilitate offshoring and outsourcing, particularly in service industries, other technologies could have the opposite effect of shortening GVCs. According to some authors, robotics, automation, and computerised manufacturing, amongst others, could reduce the advantages of production in low-labour-cost developing and emerging economies, hence curtailing the progress of international fragmentation of production (Seric and Winkler, 2020). Similarly, additive manufacturing technologies such as 3D-Printing hold the potential to align products more closely to customer specifications and could thus reinforce a trend towards the regionalisation of production. Technologies like 3D printing have received a boost by the COVID-19 pandemic and have, in many countries, been used to remedy shortages in medical supplies, including to produce ventilator valves and other ventilator parts, as well as face masks and plastic shields (Hale, 2020).

Although digitalisation had long been underway before the outbreak of the COVID-19 pandemic, the crisis will likely catalyse further investment in digital technologies by many TNCs. As humans are vulnerable to the health impacts of pandemics, more automated production processes and logistics can help increase the resilience of production during public health crises. The use of robotics and production automation has been growing, particularly in the industries most exposed to international competition, such as those in automotive, computer and electronics sectors. Against the background both of COVID-19 and the continuously sinking investment costs of robots, the trend towards automation could be reinforced by companies in the near future (Marin, 2020): whether that will reduce participation in GVCs is still unclear. Seric and Winkler (2020) argue that for countries engaged in innovative GVC tasks, no reduction of their participation in GVCs can be observed so far.

Whether the trend towards more regionally integrated production networks involving significant reshoring to Europe will actually materialise as suggested by some of the reshoring literature summarised above, however, remains to be seen. Butollo (2020) argues that the effects of digitalisation will likely be rather mixed, and could lead to further fragmentation of global production. Against the background of shrinking wage differentials between OECD countries and emerging economies, due to wage increases in the latter (particularly in China), lead firms might use investments in digital technologies to boost productivity, thus combining digitalisation with wages that are still comparatively low, in particular for mass production processes. Similarly, new technologies in online retailing and logistics enable platform companies to combine local end configuration of products with production of components in offshore locations, and still guarantee timely delivery of the final products to end-users. Thus a marked orientation towards regionally integrated production networks is only to be expected in the case of strong consumer preferences for local products, produced to specific quality and according to specific technical standards. Herrigel et al. (2013) have shown that automobile production has increasingly followed this pattern, given regionally diverse consumer preferences and regulatory frameworks.

Antràs (2020) similarly expresses doubts that the technological trajectory of Industry 4.0, particularly in areas such as automation or 3D printing, will be particularly conducive to reversing the internationalisation of production processes. As digital technologies increase firm productivity, the optimal size of companies will also expand; these two factors will jointly lead to a higher demand for intermediate inputs, many of which will be offshore components. In support of these arguments, Antràs cites empirical studies which

have shown the largely complementary nature of digitalisation and trade (Artuc, Bastos and Rijkers, 2018; Freund, Mulabdic and Ruta, 2019; Stapleton and Webb, 2020). Advances in ICTs such as video conferencing tools will facilitate the management of long-distance GVCs, as it reduces the need for business travel.

By way of summary, the impact of digitalisation on the future of international production thus remains to be seen and will depend on the type of digital technology considered: ICTs, for instance, will have quite different effects than automation or additive manufacturing. With respect to the impact of digitalisation on employment, most experts agree that the effects on employment when production is reshored in combination with investments in digital production technologies will be positive but limited to the host country, while, of course, negative for the country of origin, i.e., the country of production before reshoring. Similarly, the types of jobs created by digitalisation will be qualitatively different, requiring workers to acquire new digital skills. This makes digitalisation particularly challenging for less-developed countries, limiting their possibilities to access GVCs.

## 2.5 Synthesis: Assessing the likely impact of economic, technological and political drivers

After outlining the main trends of GVC-related production during the last four decades, and discussing emerging economic, technological and political drivers of change, we now aim to present a tentative assessment of the effects of these drivers on the spatial configuration of production in a post-COVID-19-pandemic world.

With respect to economic factors, we differentiate on the one hand between factors that have been prominent drivers of offshoring and outsourcing in the past (Economic Factors I), such as international wage cost differentials, low transport costs, access to raw materials, access to emerging markets, and regulatory differences, etc. To this we might add factors that have emerged as a consequence of previous offshoring and outsourcing activities, such as high sunk costs due to high FDI fixed costs and the resources expended by lead firms for developing high-quality and efficient production and sourcing networks. On the other hand we can point to economic factors that will contribute to the shortening of GVCs (Economic Factors II), such as quality issues, the importance of proximity to market, the importance of proximity between manufacturing and innovation activities, short lead times and consumer preferences for locally produced goods ('Made-in' effects), etc. We generally consider Economic Factors I as continuing to exert pressure on companies to offshore and outsource. However, these pressures will likely decrease over time, as, for instance, wage cost differentials further diminish and possibilities for regulatory arbitrage become more circumscribed. In contrast, we foresee a rise in the relative impact of Economic Factors II on the shortening of GVCs.

Given the distinct nature of digital technologies, a differentiated perspective is needed. As in the past, ICT technologies will likely continue to promote offshoring and outsourcing, particularly as these technologies are mainstreamed into an increasing number of segments of the service economy. The effects of automation on the spatial configuration of production might involve both an increase in local production, including through reshoring and nearshoring as the importance of wage cost differentials vanishes, or it may promote further offshoring, as automation helps production processes in emerging economies to strengthen their productivity. A more widespread application of additive manufacturing technologies will likely promote local production, particularly for higher-value customised products, or might be encouraged by governments with a view to establishing multi-purpose production capacities for emergency situations. All in all, we cannot necessarily predict that digitalisation as a whole will have clear push effects towards shorter and more regional/local production.

The growing frequency of exogenous shocks, both man-made and natural, could trigger a shortening of GVCs and encourage more regionalised forms of production. This has less to do with a change in the business models of companies; for reasons of efficiency, companies might prefer to focus their efforts on

shielding their GVCs from shocks through resiliency-enhancing measures that maintain the spatial configuration of their GVCs largely intact. Concerns regarding the security of supply, motivated by an increasing number of shocks, will, however, reinforce the role of governments. As a consequence the pressure on companies to shorten their GVCs is expected to rise, in particular as governments introduce measures that (i) provide incentives to nearshore and reshore production, and/or that (ii) place resiliency obligations on companies, which render highly fragmented and geographically disperse GVCs more costly and resource-intensive to manage. Assuming that over time a preference for resilient products develops amongst consumers — similar to the preference for sustainability — lack of attention to security of supply concerns will become a reputational risk for companies.

The trend will be exacerbated by geopolitical developments, though, of course, depending on the future trajectory of the systemic rivalry between the US and China, their respective efforts to curtail each other's economic and technological capacities will include the building-up of spheres of influence. This will contribute both to the shortening and to the regionalisation of production systems, and, to some extent, even to the decoupling of strategic rivals from access to specific technologies, products, or strategic resources. Under such circumstances other political entities, including the EU, will risk being at the mercy of one of two strategic rivals in order to have access to these technologies, products or strategic commodities. Thus these governments might opt to establish their own production networks in strategic sectors, which will arguably involve pressure on domestic companies to reconfigure their GVCs, including through reshoring and nearshoring. All in all, geopolitics might have a strong effect on the spatial configuration of production in the future.

**Table 1:** Assessing the potential of economic, technological and political factors upon the spatial configuration of GVCs

Driver	Effects on spatial reconfiguration of GVCs
Economic factors I (cost differentials, sunk investment costs)	-
Economic factors II (quality issues, transport costs, proximity of market, Made-in effects etc.)	+
Digitalisation – ICTs	-
Digitalisation – Automation/Industry 4.0	+/-
Digitalisation – Additive Manufacturing	+
Exogenous shocks (pandemics, climate events etc.)	+
Geopolitical reordering/long-term change in economic policy outlook	++

Source: own elaboration

Note: ‘-’...longer GVCs; ‘+/-’...no clear effect; ‘+’/’++’...shorter/very short GVCs

### 3 Reshoring — concepts and policy frameworks<sup>4</sup>

This section assesses different conceptualisations of reshoring and presents a review of recent policy discussions on reshoring in the context of the COVID-19 pandemic, with a particular focus on the EU.

#### 3.1 Conceptualisations of reshoring

Over the last ten years, the debate on reshoring has intensified, particularly in light of developments in the international business and management literature. In general terms, reshoring refers to the processes of bringing industries and value-creating activities ‘home’ to a specific location (Kinkel and Maloca, 2009; Gray et al., 2013; Arlbjørn and Mikkelsen, 2014; Fratocchi et al., 2014). Further distinctions can be made between backshoring and nearshoring (Eurofound, 2019; Piatanesi and Arauzo-Carod, 2019).<sup>5</sup> Backshoring occurs when manufacturing activities return to their initial country of origin, while nearshoring occurs when manufacturing is relocated to a country closer to ‘home’. This study discusses the concept of reshoring/backshoring in the context of bringing industries back to the EU from non-EU countries. This definition excludes any process of intra-EU ‘reshoring’; where reference is made to the relocation of manufacturing activities within the EU, this is explicitly indicated.

The terminology of reshoring is thus fundamentally territorial. It is a question of where manufacturing is located, rather than by whom it is performed (that is, whether the manufacturing is insourced or outsourced). Much of the literature on reshoring also tends to present the concept as a reversal of offshoring (see Gray et al., 2013). However this may be misleading, since the nature of specific industry segments, the way in which businesses operate, the types of jobs they provide and the motives and strategies behind their investment decisions have all changed over time (see, e.g., Procher and Engel, 2018). Nonetheless in order to understand (potential) reshoring processes, one does need to understand the processes that led to offshoring and the necessary changes that may allow for reshoring to take place (Gray et al., 2013).

It is also important to appreciate questions of differentiation within the overall concept of reshoring. Following the conceptualisation of reshoring as a location decision, Gray et al. (2013) distinguish between four different modes of reshoring (Figure 5): (i) in-house reshoring, where firms relocate manufacturing activities performed by wholly-owned offshore facilities to wholly-owned onshore facilities; (ii) reshoring for outsourcing, where firms relocate manufacturing activities performed by wholly-owned offshore facilities back to onshore suppliers; (iii) reshoring for in-sourcing, where firms relocate manufacturing activities performed by offshore suppliers to wholly-owned onshore facilities; and (iv) outsourced reshoring, where firms relocate manufacturing activities performed by offshore suppliers back to onshore suppliers. Since reshoring incorporates a variety of ownership modes, distinctions can also be made between captive backshoring (backshoring of wholly-owned production sites) and outsourced backshoring (backshoring from foreign-based suppliers to home-based suppliers) (Kinkel, 2014, p. 64). Barbieri et al. (2018) argue that reshoring phenomena can be differentiated in terms of (i) *what* is reshored (i.e., whole industries or only specific segments of a value chain); (ii) *who* is reshoring (i.e., the characteristics of firms implementing reshoring strategies); (iii) *why* firms are reshoring (i.e., what are the changing factors and drivers); (iv) *how* they reshore; (v) *where* they reshore to; and (vi) *when* they decide to reshore (i.e., the influence of contingent factors such as the economic crisis, the COVID-19 pandemic, or other changing factors).

<sup>4</sup> The section is partly based on Raza et al. (2021)

<sup>5</sup> The literature often uses reshoring and backshoring interchangeably. Inshoring, backsourcing, onshoring, back-reshoring (Fratocchi et al., 2014), homeshoring (Tate et al., 2014; Pegoraro, De Propriis and Chidlow, 2020) and hop-shoring (Pegoraro, De Propriis and Chidlow, 2020) are also related terms used in the literature. Indirect reshoring is sometimes used to refer to a firm’s decision to increase capacity in the home country instead of abroad.

**Figure 5:** Modes of reshoring

		<i>To: Onshore</i>	
		In-House	Outsourced
<i>From: Offshore</i>	In-House	In-House Reshoring	Reshoring for Outsourcing
	Outsourced	Reshoring for Insourcing	Outsourced Reshoring

Source: Gray et al., 2013, p. 28

For this study, questions of *why* and *when* reshoring occurs are of particular importance. The main drivers of reshoring are similar to those of offshoring and include issues related to (i) cost, (ii) quality, (iii) time and flexibility, (iv) access to and management of skills, knowledge or infrastructure, (v) risks and uncertainties, (vi) market, and (vii) other factors (Stentoft et al., 2016; cf. Benstead, Stevenson and Hendry, 2017). Offshoring dynamics have been largely explained by the logic of the smile curve<sup>6</sup> (Mudambi, 2007, 2008), which highlights the offshoring of low-value activities in any given supply chain. However, other factors such as preferential market access also play an important role in investment decisions. As a result of sector-specific offshoring and outsourcing processes, different types of GVCs have emerged, in which multinational lead firms organise highly decentralised global production networks through different governance modes (Gereffi, 1994, 1995a; Gereffi, Humphrey and Sturgeon, 2005). Reshoring dynamics in the last decade, in contrast, were linked particularly to wage growth in previously low-cost countries and to the impacts of automatisisation/robotisation processes. From a simple business perspective, reshoring occurs when trade-offs between cost-advantages, transactions costs, market and knowledge-seeking and maintaining direct control are no longer perceived to be an advantage for the firm (Kinkel, 2020, p. 197). In this context, reshoring may also express a certain change in company priorities with regard to locational advantages related to market proximity, lead times or production costs.

Against this backdrop, Tate and Bals (2017) and Hilletoft et al. (2019) argue that firms need to focus on rightshoring. This means they should aim to balance global and local supply chains, taking a holistic view in accordance with their specific needs. Hilletoft et al. (2019) highlight that from this perspective, knowledge management and transfer become particularly important since offshoring/outsourcing can create knowledge and skill gaps that may impede reshoring strategies in the future. The relationship between reshoring and Industry 4.0, and the role of digitalisation in relocating production (Arlbjørn and Mikkelsen, 2014; Ancarani and Di Mauro, 2018; Dachs, Kinkel and Jäger, 2019; Kinkel, 2020) offers an interesting further contribution to the debate. The concept of rightshoring is thus of particular significance for a differentiated approach to reshoring in the current macroeconomic and political context.

<sup>6</sup> The smile curve highlights that low-value activities such as manufacturing are often offshored to low-income countries, while high-value activities such as research and development or marketing remain in high-income countries.

## 3.2 Reshoring in EU policy frameworks

There has been a debate within the EU for some time already on the need to strengthen the security of supply for critical products. It is a debate, which has intensified in light of the COVID-19 pandemic. As many critical products are manufactured via GVCs, the debate has necessarily focused on the role of GVCs for contemporary production processes. However, while security of supply concerns are considered a perfectly legitimate public policy objective by all participants in this debate, positions on the respective role for active government interventions into the locational decisions of companies, including through reshoring policies, have differed markedly. Thus while the existence of trade-offs between the goals of increasing economic efficiency and security of supply is widely recognised, the question of whether reshoring is both an effective and efficient policy for increasing the security of supply is still highly contested. In the following sections, we will scrutinise the principal policy frameworks that relate to this debate. We will start with providing an overview on the debate on GVC resilience. Based on our assessment of the resilience debate, we will then discuss how the policy debate on the (open) strategic autonomy of the European economy addresses the issue of security of supply and how it responds to the strategic challenges emanating from the great power rivalry.

### 3.2.1 The debate on the resilience of Global Value Chains

#### The concept of GVC resilience

Global supply chains are governed by lead firms, which typically take decisions on the location of production and sourcing from other firms. Decisions are made mainly on the basis of costs, quality management issues and speed of delivery (lead times). In this context companies often prefer single-sourcing strategies, as these reduce transaction costs for buyers and incentivise suppliers to grant price reductions (Petersen, 2020). Thus, GVCs have been mostly determined by such efficiency considerations, while risk management approaches paying attention to security of supply have only been of secondary importance in the management practices of firms (Bogaschewsky, 2020).

A key concept, when dealing with the risks to which GVCs are exposed, is resilience. The OECD (2019) defines resilience as “the ability of households, communities and nations to absorb and recover from shocks, whilst positively adapting and transforming their structures and means for living in the face of long-term stresses, change and uncertainty. Resilience is about addressing the root causes of crises while strengthening the capacities and resources of a system in order to cope with risks, stresses and shocks.” In the risk management literature, the concept of *resilience* is contrasted with that of *robustness*. While resilience is defined as the ability to return to normal operations over an acceptable period of time post-disruption, robustness is the ability to maintain operations throughout a crisis (Miroudot, 2020; Brandon-Jones et al., 2014). From a company perspective, a risk management approach based on resilience may differ from one based on robustness. For example, when applying a resilience approach, a company might be willing to accept an interruption of operations during a crisis and instead focus on re-establishing operations quickly post-disruption. In this context, companies might prefer to pursue a single-sourcing strategy, as the long-term working relationship with one supplier will facilitate adherence by the supplier to risk management standards. In the case of vertically integrated production, companies might focus on developing plans and procedures for the swift re-establishment of operations post-disruption, while using buffer stocks to maintain supply during the disruption itself. A robustness approach, on the other hand, might instead lead companies to prefer multi-sourcing strategies over single-sourcing strategies, making it possible to switch between suppliers in the event of a crisis, and/or to establish multiple production sites in order to secure production redundancies. Robustness strategies, however, involve substantial costs, as working relations with multiple suppliers have to be established, quality issues settled, adherence to standards and lead times monitored, cost mark-ups for sourced inputs due to smaller orders accepted, and so on. Thus in many cases, companies might prefer resilience approaches in their supply chains. Although

some strategies are common both to resilience and robustness, the fundamental difference is that resilient firms tend to reduce their risks while not investing significantly in anticipating and avoiding all forms of disruption. Such firms prefer to weather the disruptions and focus on minimising their impacts (Miroudot, 2020).

It is difficult to argue in general terms that one strategy is superior to the other. There is some evidence that supplier diversification is associated with a slower recovery from supply disruptions, whereas the use of long-term relationships is associated with more rapid recovery (Jain et al., 2015). However, ultimately, the selection of the optimal risk management strategy will depend on the characteristics of the respective GVC as well as the importance — or criticality — of the respective goods to the security of supply for the general public. While, for many products, a resilience-based risk management approach might suffice, particular products such as, for example, pharmaceuticals, may benefit more from a robustness-based approach. Given the costs involved, which might increase prices and thus negatively affect competitiveness, companies may lack the intrinsic motivation to engage in effective risk management. This readiness must be created, if necessary, by policymakers.

A more comprehensive approach going beyond the company level is the 'systemic resilience approach' developed by the OECD's New Approaches to Economic Challenges (NAEC) group. Based on systems thinking, this approach argues that efficiency and resilience are in a state of tension, and given the complex interrelations between sub-systems, policies must be geared towards creating absorptive buffers, capacity reserves and redundancies in order to prevent an initial, small-scale crisis from cascading and multiplying throughout the entire system and thus leading to a more serious crisis. This is particularly topical for systemic threats, such as pandemics or climate change, which are characterised by their capacity to percolate across complex interconnected systems — either through an abrupt shock or through gradual stress (IRGC, 2018).

Systemic threats are particularly difficult to model and calculate via a risk-based approach. Systemic risk events are difficult to predict, and the disruption caused by such events tends to be indirect as a result of nested interaction effects. The global financial crisis of 2007/2008, for example, began as a collection of relatively contained failures at the hands of a limited number of financial firms but ended in substantial financial collapse across much of the world (OECD, 2019, p. 6). In this context, traditional risk management is not enough, given its focus on crisis prevention and risk mitigation. It is, instead, critical to accept the inherently uncertain, unpredictable, and even random nature of systemic threats and to address them through building system resilience (OECD, 2019).

### **The policy debate on GVC resilience during COVID-19**

An initial discussion on GVC resilience took place in the aftermath of the 2007/08 global financial crisis. In an edited volume collecting various case studies, Cattaneo, Staritz and Gereffi (2010, p. 6) concluded that, by and large, GVCs have proven resilient: "They have become crucial and enduring structural features of the world economy. In the aftermath of the Asian financial crisis in the late 1990s, similar discussions about 'the end of globalization' and the 'retrenchment of global production arrangements' in the Asian context arose, but global supply chains bounced back more quickly than expected." Writing in response to the COVID-19 pandemic, Gereffi (2020) advocates for redundancy rather than reshoring in order to bolster the robustness and resiliency of supply chains. Lead firms should diversify their supply chains in multiple ways in order to retain scale economies, reasonable costs, and innovation opportunities. Strategic options could include bolstering capacity in the home country to address security concerns and to ensure the continued production of products deemed essential and expanding the number of international production sites to avoid overreliance or dependence on only one or two locations. Resilience-enhancing measures do not only involve geographical strategies such as setting up production locations in different jurisdictions and sourcing the same components from different suppliers, that is, creating supply chain redundancies, but may also entail a variety of additional measures, such as introducing monitoring, due diligence and early

warning mechanisms, and increasing the strategic stockpiling of critical inputs. Such measures could be introduced by companies themselves, or they could be required by governments and public regulators to strengthen security of supply.

Other recent work, for instance, the volume edited by Baldwin and Evenett (2020), two well-known liberal trade economists, addresses the issue of resilience, particularly in its potential relation to regionalisation/localisation of production. Unsurprisingly it warns against the export restrictions that many governments had implemented during the early phase of the COVID-19 crisis, arguing instead that “national trade barriers in a world of internationalised manufacturing processes will make it harder for every nation to produce vital medical supplies. Trade is not the problem; it is part of the solution. Insular policies will also fail to foster economic recovery and they are a threat to the collaborative spirit that the human race will need to defeat this threat” (ibid., p. 1). Essentially their case against increased regionalisation/localisation of production, including through processes of reshoring, rests on two key arguments. Firstly, they maintain that concentrating production domestically will not increase resilience, since local production can still be interrupted by a crisis and that even localised production would likely require the import of certain resources. In addition they suggest that the regionalisation/localisation might disrupt complex established systems of production and, paradoxically, lead to diminished security of supply. Secondly, they argue that concentrating (more) production domestically will be economically inefficient, because of higher production costs resulting in higher prices for end consumers. Resilience is thus better served when the geographic concentration of production and supply bottlenecks are mitigated through company strategies for diversifying suppliers and production locations at a global scale.

Similar arguments have been voiced by the OECD in its work on resilience with respect to the COVID-19 crisis. Emphasising that interconnectivity between systems is one of the determining features of the modern world, it argues against the “instinctive reaction to the COVID-19 outbreak [...] to limit or reduce such interconnectedness” on the basis that “such sweeping policy changes would not better protect countries or international markets against future systemic threats”. Instead, they argue that “an emphasis upon developing resilience within the international economic system is a necessary evolution for a post-COVID-19 world” (OECD, 2020a, p. 11).

A problematic assumption in the liberal internationalist argument is that the obvious advantages of an open international division of labour compel countries to cooperate and maintain trade openness, even during periods of uncertainty and crisis. Though intuitively appealing, this assumption is not corroborated by the available historical evidence. In situations of crisis, the immediate concern of national governments is to guarantee the supply of essential goods to its own population. This trumps the willingness to adhere to standards of international cooperation and commitments under international law. According to the WTO, some 90 countries invoked more than 230 temporary measures to restrict exports since the outbreak of COVID-19. That there is such a high number of countries invoking export restrictions during the COVID-19 crisis is just the latest in a long history of similar episodes. Export restrictions have been employed for a variety of reasons, for instance, commodity price hikes, supply shortages, or political-strategic motivations. They have been applied to a variety of goods, including agricultural and food products and strategic raw materials (see Anderson 2009). Prior to the COVID-19 pandemic, the most recent example of such restrictions being widely employed was the global food crisis during 2007–2011 (see Sharma, 2011). Given the historical evidence on the self-serving nature of economic crisis management by national governments, which includes EU Member States even in their trade with each other, international openness and cooperation may, in theory, be the first-best solution for regulating GVC-based production and the distribution of essential medical and other products during periods of crisis. As the historical record shows, however, their efficacy in crisis periods is threatened by national egoisms.

The liberal argument further emphasises the importance of supplier and geographic diversification for mitigating supply bottlenecks. Though correct in principle, geographical diversification of suppliers is

costly, and companies have so far demonstrated a propensity to stick to single-sourcing strategies. The argument also fails to account for the uncertainty associated with international cooperation. Suppose, for example, that a sourcing bottleneck for critical medical products from China leads to the establishment of new production facilities in other important low-cost production countries, say in India and Brazil, a crisis might still trigger export restrictions being imposed in all three producer countries, thus interrupting the supply chain. Given a government's responsibility for security of supply with critical goods during a crisis and the high levels of uncertainty associated with international cooperation, relying solely on international sourcing is not a rational choice. In such situations, setting up production capacities in the domestic economy could become part of a more effective geographic diversification strategy, as it increases the overall number of production sites. It also allows for more targeted government intervention since, in the event of a global crisis, governments are able to implement domestic policy measures to regulate or influence domestic production. This is not possible when manufacturing is confined to offshore countries, since the typical government cannot force other countries to adhere to international commitments for the free flow of goods during situations of crisis. Reshoring may therefore be preferable if it could help guarantee a certain minimum of domestic production. Indeed, it is not surprising that almost all governments, at least in the OECD world and in emerging economies, have resorted to helping set up new local production facilities — or scale-up existing ones — for the manufacturing of Personal Protective Equipment (PPE) during the COVID-19 crisis. This does not preclude efforts to uphold international cooperation during a crisis, but it makes clear that precisely because governments have to explore all possibilities for maintaining security of supply, they will also promote domestic production, including by providing incentives to companies to reshore parts of their production.

The second core argument emphasised by the liberal resilience discourse relates to efficiency. Reshoring production back to Europe, it is argued, is not only un conducive to resilience but also inefficient, as production costs in the OECD world are markedly higher than those in the offshore locations where the production of especially low-tech and labour-intensive production is currently taking place. Looking purely at economic efficiency, the argument is obviously correct, yet it fails to paint the full picture. Taking into account externalities, social costs of production in offshore locations are much higher than the private costs of production. Given lower environmental standards, particularly in developing and emerging economies, the environmental externalities of production in offshore locations are sizable, particularly in raw-material intensive heavy industries. (see e.g., Wiedmann and Lenzen, 2018; EC, 2013). Similarly, the environmental externalities of long-distance transport are also not accounted for in the conventional cost calculus. With respect to the carbon footprint of EU imports, it is noteworthy that net imports of CO<sub>2</sub> have increased by some 33 % since 1990, rendering the EU, with 728 million tons, the world's largest net importer of CO<sub>2</sub> emissions in 2017 (Felbermayr and Peterson, 2020, p. 7f.). Last but not least, breaches of basic labour rights in production, and the negative effects on the rights and livelihoods of affected local populations, have to be considered. While monetising environmental and social externalities involves complex methodological issues and the empirical literature is limited, the cost differentials reported between offshored production and production in OECD countries do typically overstate the real cost differentials when taking into account the aforementioned externalities.

Under efficiency considerations, the first-best solution for internalising these externalities would be for offshore countries to raise their environmental and social standards, establishing a level playing field with local production in OECD countries, while still profiting from lower wages. Alternatively, offshore suppliers could be required by lead firms to comply with strict environmental and social standards. The incentives for stakeholders to follow this path are, however, somewhat limited. For governments, introducing environmental and social legislation might erode the competitiveness of local industries, with negative effects on the tax base, employment and foreign currency income. For suppliers in offshore countries, it will increase the costs of production and thus decrease profitability and competitiveness. For lead firms in OECD countries, due diligence requirements will increase sourcing costs and reduce profits. The success of

efforts based on voluntary commitments as the UN Guiding Principles on Business and Human Rights has hitherto been mixed, leading EU policymakers, more recently, to contemplate the introduction of mandatory due diligence requirements. With respect to long-distance transport, the international community would have to agree on pricing transport-related carbon emissions through, for instance, the introduction of a global carbon tax. Of course, such a solution is predicated on the willingness of all countries to reach an international agreement and to implement it domestically. As any such agreement would impact countries' competitiveness, reaching an agreement will be difficult and protracted, as we have also witnessed throughout the history of climate negotiations. The hurdles to overcome in order to implement the first-best solution are formidable.

To the extent that domestic production in OECD countries is taking place under higher environmental and social standards than in offshore locations, and potential breaches of these standards by companies are more effectively sanctioned by OECD governments, reshoring of production could be seen as a contribution to a viable second-best solution to the problem of production sustainability. Emerging economies will, of course, lose jobs in case of reshoring. However, if vigorously pursued by OECD governments, reshoring in response to both resiliency concerns and sustainability imperatives might arguably exert pressure on governments in offshore countries to upgrade their environmental and human rights policies, to support those local export sectors under threat of losing access to international supply chains. Similarly, governments in offshore jurisdictions might be more willing to agree to international agreements on pricing transport-related carbon emissions.

By way of summary, our discussion has underlined the case for EU policymakers to seriously consider policies for increasing the resilience of GVCs. The stringency of such requirements, that is, if they follow a resilience or a robustness approach, needs to be defined at a sector — if not a product — level. Resilience-oriented policies might include a combination of different measures, such as monitoring obligations, due diligence requirements and stockpiling. We would, however, contend that GVC resilience policies alone might not suffice for achieving a level of security of supply deemed necessary by policymakers, particularly in the case of systemic threats such as pandemics, and for products deemed critical. For critical products with pronounced sourcing bottlenecks, such as, for example, pharmaceuticals, governments may wish to resort to other and arguably more interventionist policy options, including reshoring.

### 3.2.2 (Open) Strategic Autonomy

Another global trend that increasingly determines the course of economic policy, including security of supply concerns, is the return of geopolitics. China, the very country that has become the key supplier of a wide portfolio of essential goods and commodities, has also become involved in a geopolitical conflict with the US. Chinese exports do not only include pharmaceutical products, but also many other products and critical inputs including rare minerals and other metals such as magnesium, bauxite or titanium, which are not only important from a security of supply perspective but are essential for implementing ecological innovation and are key to achieving the objectives of the European Green Deal. A recent analysis by the Commission highlights that strong EU import dependencies exist for 30 important metals, in particular from China, but also from Turkey (98% of borate imports), or Brazil (85% of niobium imports). A discussion on exploiting the dependency of many countries on such goods and commodities as a political weapon has recently been surfacing in Chinese political circles. Against China's more assertive stance in international affairs, which has already led the Commission to qualify China as a 'systemic rival' (EC, 2019), EU policymakers have become increasingly concerned about the EU's import dependency vis-à-vis authoritarian regimes and its potential vulnerability to political blackmailing.

In its Global Strategy for the EU's Foreign and Security Policy launched in 2016, the Commission introduced the concept of 'strategic autonomy'. The scope of the concept at the time remained limited and referred in particular to defence cooperation and the European defence industry. Against the backdrop of the COVID-19 crisis, former EU Trade Commissioner Phil Hogan referred to the term 'open strategic autonomy',

highlighting that global supply chains would need to be diversified in some sectors, including, where necessary, through strategic stockpiling. At the same time, he stressed that this would require a deepening of the international rules-based trading system, and reiterated the EU's continued commitment to such a system. According to this view, a move towards strategic autonomy in certain sectors would have to be balanced with a continuing commitment to an openness to trade and the multilateral trade framework. In political terms, there is also a need to strike a balance between a group of EU countries, led by France, demanding a more assertive external economic and industrial policy in the EU, and a second group of export-oriented countries, led by Germany, preferring a more cautious approach in order to avoid aggravating important trading partners.

With respect to the issue of advanced technology and the strategic competitiveness of the EU economy, the discussion is already moving further. As it is becoming increasingly apparent, the key objective of the US 'trade war' against China is to slow down Beijing's quest towards technological leadership in high-tech industries. Recent US moves against Huawei, China's leading manufacturer of communication technology equipment, aim at cutting the company off from export markets and impeding its ability to source critical components such as semiconductors. Similarly, the US tries to incentivise reshoring of microelectronics manufacturing to the US. A number of large US companies, including Walmart, General Electric, Ford and Whirlpool, have announced plans to reshore production capacity to the US. With this, the Trump administration is taking heed of military intelligence that, for years, has called for a stronger focus on maintaining the US technological lead in high-tech and particularly in digital technologies. As outlined above, the Realist thinking underpinning the views of the US security establishment strongly emphasises the importance of technological superiority for the military capabilities of a nation. Therefore, hindering the technological catch-up of China has become a top priority of US foreign policy. For all that is known, this strategic approach is widely shared amongst Democrats and will thus arguably be continued under a Biden presidency, albeit on the basis of a more considered approach.

What is more, over the last two decades, Chinese companies have become increasingly pro-active in acquisitions of foreign companies, including in Europe. The stock of Chinese FDI increased by a factor of 75 in the period 2000–2019 (UNCTAD, 2020b, Annex Table 2), rendering China the second-largest outward investor in 2018. Takeovers of EU high-tech companies by Chinese investors have made headlines in recent years, as was the case with German robotics company KUKA or telecom company 50Hertz. In reaction to this increasing technological competition, several EU Member States, as well as the Commission itself, have stepped up efforts to control takeovers of EU firms by foreign companies. The EU Foreign Investment Screening Regulation (Regulation 2019/452) creates a mandatory information-sharing mechanism between Member States and allows Member States and the Commission to comment on foreign investments foreseen in other Member States. With the Regulation, the EU aims to safeguard Europe's security and public order by introducing an EU-wide foreign investment screening mechanism and scrutinising purchases by foreign companies that target the EU's strategic interests. The Regulation entered into force on 11 October 2020 and applies to foreign direct investments concluded after 10 April 2019.

Given Member States' competencies with respect to investment issues, the EU's role in the Regulation is essentially confined to coordination. The Regulation contains a non-exhaustive list of industries and sectors that could trigger a screening exercise, including (i) critical infrastructure (energy, transport, water, health, communications, media, data processing or storage, aerospace, defence, electoral or financial infrastructure and sensitive facilities); (ii) critical technologies and dual-use items (artificial intelligence, robotics, semiconductors, cybersecurity, aerospace, defence, energy storage, quantum and nuclear technologies, as well as nanotechnologies and biotechnologies); (iii) critical inputs (energy, raw materials and food security); (iv) access to sensitive information (personal data); and (v) media freedom and pluralism. In response to the COVID-19 pandemic, FDI screening was expanded to include the health sector and the Commission issued a Guidance to Member States addressing the possibility of non-EU investors

attempting to acquire health care capacities or related industries through FDI during the pandemic. The Commission recommended full use of national FDI screening regimes and urged Member States that do not have screening regimes to set them up (UNCTAD, 2020b, p. 111). COVID-19 thus triggered an expansion of the scope of screening exercises to include security of supply considerations.

While the regulation promotes a cooperation mechanism between the Commission and Member States to exchange information on investment screening, it does not create an EU-level regulator who could issue a binding opinion and block an investment. Nor does it require harmonisation of EU Member States' national investment screening mechanisms, or even create an obligation for them to introduce such regimes. Nonetheless, against the backdrop of a wider trend among major countries, including Australia, Canada, the UK and the US, increasingly toughening their foreign investment controls, a growing number of EU countries have recently ramped up their own investment control systems. In their national frameworks, several EU countries have already introduced stricter requirements. France, for instance, has expanded the scope of regulated sectors to include food safety. Germany, due to the Corona pandemic, added medical industries to its list of sectors and lowered its threshold for the authorisation of foreign takeovers of critical infrastructures to 10%. In its 'New Industrial Strategy for Europe' dated 10 March 2020, the Commission, in turn, announced its intention to contemplate further measures to tighten the investment control system in the EU, although concrete measures are still pending.

By way of summary, we have seen that the discussion on (open) strategic autonomy has addressed security of supply concerns, mainly through the proposed investment screening policies. Investment screening might lead to a slowing-down of offshoring activities, with the knock-on effect that production is reshored. The explicit goal of investment screening is, however, to inhibit the loss of control over key technologies and industries to foreign interests and, therefore, the debate on the EU level still has to explicitly address the role of reshoring policies as a possible element of an open strategic autonomy conception.

### 3.2.3 Towards a comprehensive concept of strategic autonomy?

What emerges from this overview of the debate on open strategic autonomy is that the capacity of the EU to respond to an increasingly more dynamic geopolitical reordering is constrained by both substantive divisions and institutional impediments. With respect to the institutional constraints, the economic policy framework with its focus on free trade, the emphasis on competition and strict disciplines on policy interventions, while lacking crucial macroeconomic and fiscal competences, is enshrined in the Treaties and the legal framework. This is complemented by limited competences in foreign and security affairs and a complex system of multi-level governance. There is a danger that the institutional complexities and conflicting interests are exploited by the US, China and others (in particular Russia) to weaken consensus formation and prevent the EU from arriving at common positions. Notwithstanding these difficulties, under the threat of severe exogenous shocks such as, most recently, the COVID-19 pandemic and the global financial crisis, EU politics has eventually been able to move forward with projects of a strategic trajectory, such as, for instance, the EU recovery plan 'Next Generation EU' and the European Green Deal initiative.

As outlined above, the policy debate on the need to increase the security of supply with essential products triggered by the COVID-19 pandemic is a necessary, though by no means sufficient, element of a more comprehensive discussion on resilient and sustainable production systems. Of course, given the rise in the number and scale of natural disasters to be expected in the future, effective policies to increase the security of supply for essential products and services is highly relevant. The ongoing geopolitical reordering of the international system in combination with the imminent digital transformation, however, add a strategic dimension to this discussion. If the EU and its Member States want to retain the policy space to tackle these grand societal challenges, a more comprehensive policy approach on strategic autonomy will arguably be necessary.

Such an approach should, however, not only discuss the organisation of production from the point of view of security of supply. It will also be necessary to maintain and expand the productive and technological capacities and capabilities of European economies in order to tackle the grand societal challenges of the future, and in particular to manage the pressing socio-ecological transformation of our energy and material-intensive production and consumption model in accordance with the objectives of the European Green Deal. If the EU seeks to be a leader in this venture, it must safeguard its technological potential and have the ability to employ it to master the transformation of our energy, transportation and production systems. In addition to large 'mission-oriented' public research and innovation programmes, this will also entail the selective utilisation of more interventionist policies, particularly in strategically important sectors. The special state aid regulations for Important Projects of Common European Interest (IPCEI) have been a first step to promote technological projects of a strategic significance, including the data infrastructure project Gaia-X, the European Battery Alliance, an IPCEI on microelectronics and others.<sup>7</sup> The basic idea behind these initiatives is to achieve technological sovereignty in high-tech sectors, which are of strategic value for EU competitiveness and where European companies are late comers and dependent on technologies from firms in other countries, in particular from the US and China.

This combines with the recent debate on technological sovereignty, which has been promoted since the outbreak of COVID-19 by key EU policy-makers, including German Minister of Economic Affairs Peter Altmaier and Commissioner Thierry Breton.<sup>8</sup> Various elements and meanings have been proposed. For instance, Commissioner Breton has identified the following key elements: firstly, digital sovereignty with the three pillars computing power, control over our data and secure connectivity; secondly, technological autonomy, with enhanced EU cooperation through the European Defence Fund in key technological projects such as drones, combat aircraft, the European tank, space capabilities and cybersecurity; and thirdly, technological sovereignty with respect to green technologies and the objective of making Europe the epicentre of 'green tech', requiring EU policy to strengthen value chains, diversify essential supplies and even relocate production.<sup>9</sup>

The boundaries of the concept and the respective role of different policy instruments have however not been worked out properly so far. In our view, it is important to start from a concise definition of the concept of technological sovereignty. The definition of Eder et al (2020) provides a useful starting point. They define technological sovereignty as "the ability of a state or a federation of states to provide the technologies it deems critical for its welfare, competitiveness, and ability to act, and to be able to develop these or source them from other economic areas without one-sided structural dependency." In their conceptualisation, technological sovereignty is not only required for fulfilling the traditional sovereign tasks of states, like defense and public security, but also for meeting society's needs, and to preserve economic competitiveness (see Figure 6).

What is more, technological sovereignty is considered a necessary component for maintaining the dynamic capabilities and capacities of societies to tackle current and future challenges, such as pandemics and the green transition. Basically, two important policy implications follow from this approach. Firstly, the technological fields where threats to technology sovereignty exist, should be identified as precisely as possible. Secondly, the promotion of technology sovereignty needs a strategic approach to policy-making, including a variety of instruments. Sufficiently broad investments in research and development (R&D) are considered the basic prerequisite for establishing sovereignty in critical technologies now and in the future.

<sup>7</sup> For more info see [https://ec.europa.eu/commission/presscorner/detail/de/IP\\_14\\_673](https://ec.europa.eu/commission/presscorner/detail/de/IP_14_673) (04.12.2020)

<sup>8</sup> See <https://sciencebusiness.net/news/decoding-europes-new-fascination-tech-sovereignty> (04.12.2020)

<sup>9</sup> See [https://ec.europa.eu/commission/commissioners/2019-2024/breton/announcements/europe-keys-sovereignty\\_en](https://ec.europa.eu/commission/commissioners/2019-2024/breton/announcements/europe-keys-sovereignty_en) (04.12.2020)

In the case that technologies identified as critical, suffer from structural import dependencies with respect to certain inputs and components, appropriate measures might include diversification of suppliers, and in our view also the promotion of domestic production including through reshoring. Again, following this concept of technological sovereignty, reshoring should be considered as one of many policy instruments applied for achieving broader societal objectives. Similar to our discussion of the issue of security of supply, the use of reshoring will depend on the analysis of the criticality of a specific technology and the existence of import dependencies and supply bottlenecks. This can only be achieved at the sector level and by analysing specific value chains.

**Figure 6:** Dimensions of and motivations for technological sovereignty

		Technology sovereignty		
		Original sovereign tasks	Meeting needs of society	Economic competitiveness
Preserve and protect (static)	Economic positioning and state functions	Defense, public security, administration	Public services, critical infrastructures, public healthcare (water supply, transport links, health system)	Creating jobs and value in existing industries (mechanical and automotive engineering)
	Being crisis-proof against	Military conflicts Terror attacks	Pandemics, climate-based crises, terror attacks	Euro crisis, structural breaks caused by transformation
Dynamic development		informational self-determination, geopolitical positioning (5G debate and EU cloud)	System transformation (sustainable mobility/ logistics, energy transition)	Creation and renewal of paths, transform and develop new sectors (e-mobility, Industry 4.0)

Source: Eder et al., 2020, p. 13

The next section will look at specific sectors that are particularly important for both security of supply and for strategic autonomy and technological sovereignty and assess their reshoring potentials.

## 4 Potentials for reshoring to Europe of selected economic sectors and their value chains

### 4.1 The empirical record on reshoring pre-COVID-19

The empirical evidence on reshoring processes is so far limited (Delis, Driffield and Temouri, 2019). Most studies present case studies focusing on specific countries, sectors or firms.<sup>10</sup> So far, and to the best of our knowledge, only four studies present a cross-country analysis to better assess the scale and scope of reshoring processes in the EU. The first three of these studies are based on an assessment of the EMS. Dachs and Kinkel (2013), Dachs and Zanker (2014) and Dachs et al. (2019) examined the frequency of, motivations for, and countries impacted by backshoring, as well as the characteristics of those companies engaged in backshoring processes between 2007 to mid-2009, 2010 to mid-2012 and 2013 to mid-2015, respectively. The fourth study by Eurofound (2019), discussed in more depth below, draws on *European Reshoring Monitor* data between 2015 and 2018.

Dachs and Kinkel (2013), Dachs and Zanker (2014) and Dachs et al. (2019) take on a country perspective, and therefore also include intra-EU reshoring. They also highlight trends and tendencies at a sectoral level, such as, for example, the extent to which companies within specific sectors are likely to engage in reshoring processes. The results, however, should be interpreted with caution, given that the analysis only covers limited periods of time. These studies indicate that the sectors with the highest propensity to reshore include electrical equipment, computer manufacturing, machinery, motor vehicles/transport equipment, communication equipment and pharmaceuticals. Location-bound sectors, i.e., sectors for which both offshoring and reshoring are limited, include the metal sector, food and beverage production, wood production, mineral production and printing. Within the analysed timeframe, leather and apparel manufacturing were also among the sectors with very limited reshoring tendencies.

In their latest study, Dachs et al. (2019), found that 105 out of 2 450 firms (4.3 %) reported backshoring activities during the analysed period.<sup>11</sup> Of these firms, 1.7 % backshored from their suppliers, and 2.6 % from their own subsidiaries. Backshoring was more common in high and medium-high technology sectors (6.7 % and 6.2 % of surveyed high/medium-high technology firms) when compared to medium-low and low technology sectors (3.2 % and 1.7 %). In this context, the authors contemplate the potential relationship between backshoring and innovation. In addition, the study found that firms producing single units are less likely to backshore than firms in batch or mass production, as single-unit production requires closer interaction with customers and is less wage-sensitive. The authors also argue that the higher share of high-tech reshoring can be explained by more frequent offshoring in high-tech compared to low-tech industries (such as paper, wood, food and beverage industries). For the same reason, larger firms are also more likely to reshore than smaller firms.

The countries with the highest share of firms engaged in reshoring included Spain (7.9 %), Austria (5.5 %), the Netherlands (4.7 %), and Switzerland (4.2 %). Firms in Croatia, Serbia and Slovenia (all 2.2 %), as well as Germany (3.2 %), represented a significantly lower share. Production was moved back predominantly from EU-15 countries (50 %), followed by other EU Member States (20 %) and then China and other Asian

<sup>10</sup> Early country case studies include inter alia those from Canham and Hamilton (2013) on New Zealand; Ellram, Tate and Petersen (2013) on the US; Kinkel and Maloca (2009) as well as Kinkel (2012, 2014) on Germany; Stentoft et al. (2015) on Denmark; and Tate et al. (2014) on the US. Recent studies show that country-based approaches still prevail, e.g., Fel and Griette (2017) on France; Heikkilä, Martinsuo and Nenonen (2018a) on Finland; Johansson and Olhager (2018) on Sweden; and Stentoft et al. (2018) on Denmark.

<sup>11</sup> The dataset includes observations from Austria, Croatia, Germany, the Netherlands, Serbia, Slovenia, Spain and Switzerland.

countries (25 %). Compared to the earlier results presented by Dachs and Zanker (2014), the authors argue that backshoring from China and other Asian countries has gained momentum (Dachs et al., 2019). However, this trend should not be overestimated, since the share of companies engaging in reshoring is still small, as is the number of companies that are relocating their production from Asia to the EU. The main drivers of reshoring reported by firms were a lack of flexibility (55 % of responses), poor quality (51 %), and unemployed capacity at home (42 %).<sup>12</sup> For firms reshoring from Asian countries, the lack of flexibility (71 %) and poor quality (79 %) was even more important (ibid.).

The fourth study, a cross-country analysis by Eurofound (2019), analyses data from the *European Reshoring Monitor* between 2015 and 2018.<sup>13</sup> The *European Reshoring Monitor* is an online database collecting information on individual reshoring cases identified in the media and other sources. Within the period of analysis, the number of reshoring cases increased almost every year, culminating in a total of 253 cases by the end of 2018 (ibid.). Almost all (92 %) of these cases reflected backshoring activities, while nearshoring accounted for only 5 %.<sup>14</sup> Eurofound (2019) takes on a country perspective in its definition of backshoring, which it sees as encompassing activities that were previously offshored and relocated to the home country in the EU. Its definition of nearshoring, on the other hand, includes the relocation of offshored activities to another EU country besides the original home country. The great majority of reshoring cases occurred in the manufacturing sector (86 %), followed by information and communication (5 %) and financial and insurance services (4 %). Regarding the frequency of reshoring in specific manufacturing industries, the findings of Dachs et al. (2019) were only partially confirmed, as two low-tech industries, apparel and food production, registered the highest number of reshoring cases (accounting for 11 % and 9 % of total cases, respectively). Nonetheless, reshoring activities were dominated by medium to high-tech industries, including machinery and equipment (8 %), computer, electronic and optical products (8 %), electrical equipment (7 %), other transport equipment (7 %), fabricated metal products, excluding machinery and equipment (5 %), and motor vehicles, trailers and semi-trailers (5 %) (Eurofound 2019). Similar to Dachs et al. (2019), most of the cases in the Eurofound (2019) study were attributable to larger companies with more than 250 employees (60 %).

According to Eurofound (2019), the UK (17 %), Italy (15 %), France (14 %), Denmark (8 %), Norway (8 %) and Germany (7 %) account for the countries with the highest numbers of reshoring cases. In most cases, production was reshored from members of the European Economic Area (plus Switzerland) (47 %), and in particular, Poland (6 %) and Germany (6 %). This was closely followed by Asia (42 %), and in particular, China (30 %). The main drivers for reshoring included firms' global reorganisation (mentioned in 24 % of all cases), delivery time (22 %), automation of processes (20 %), poor quality of offshored production (19 %), proximity to customers (17 %), and 'made in' effects<sup>15</sup> (16 %).

Eurofound (2019) provides the only assessment of the impact of reshoring on employment among the cross-country studies. The assessment is based on 99 cases (for which data was available) that were linked to the creation of 12 840 new jobs. However, the authors emphasise the high number of cases (154) within the dataset, for which no information on employment effects was provided. They conclude that, in these cases, employment gains may have been completely absent or not relevant enough to be highlighted. The reasons why reshoring does not lead to increased employment might be due to its link with automation, which reduces labour demand, and because reshoring decisions are sometimes based on strategies to leverage untapped production capacities at home (e.g., due to pressure of unions in the event of plant closures and employee lay-offs in the home country). In contrast, the authors also point out that the actual

<sup>12</sup> Further motives include transportation costs (24 %), coordination costs (22 %), labour costs (15 %), lack of qualified personnel (13 %), lack of infrastructure (11 %), vicinity to R&D at home (5 %), and know-how loss (2 %) (Dachs et al., 2019).

<sup>13</sup> For project details see <https://www.eurofound.europa.eu/observatories/emcc> (25.11.2020)

<sup>14</sup> The remaining 3 % reflect 'other reshoring strategies'.

<sup>15</sup> The 'made in' effect describes a competitive advantage for companies when selling goods produced in a specific country. The positive and negative effects of specific countries of origin depends on the perception of the consumer groups.

impact of reshoring on employment can only be assessed by also taking into account jobs that were indirectly created (i.e., jobs created in one company that may have benefited from the reshoring decision of another company). However, this information is not covered by the data of the *Reshoring Monitor*.

In addition to the above-discussed firm-level strategies, the impacts of political and institutional changes on reshoring dynamics so far remain under-researched in the empirical literature. Based on a regression model and using firm-level data on the reshoring decisions of multinational enterprises in the manufacturing sector from 14 OECD countries for the period 2006–2013, Delis, Driffield and Temouri (2019) find a strong relationship between the onset of the financial crisis and the propensity of firms to reshore.

By way of summary, the empirical evidence so far highlights that reshoring processes are on the rise, but that they are so far limited in scale and, thus, with limited effects on the EU economy as a whole. Additionally, it should be noted that an increasing number of reshoring processes does not mean that offshoring strategies are no longer pursued. Effects on employment are particularly low due to the role of automation in driving reshoring processes. The limited effects of reshoring on the EU economy are also related to the fact that reshoring so far is an intra-EU phenomenon, even though reshoring from Asia and China is rising. Larger and medium to high-tech industries are among the firms with the highest reshoring propensity. The drivers of reshoring are diverse and are often related to lack of flexibility, quality issues and the importance of proximity to specific markets/end-users. Finally, the review revealed that the literature focuses on microeconomic motivations for reshoring, while other factors such as macroeconomic crises or changes in economic policy are often not considered. For this reason, conclusions from the literature for the current COVID-19 situation and the changing geopolitical situation are limited.

## 4.2 Sector-specific potentials for reshoring

This section presents an overview of research on the potential of specific sectors for reshoring to the EU. We draw on two studies that assess the general likeliness of sectors to reshore/geographically shift in the near future, and four empirical studies that analyse reshoring processes across sectors over the last ten years.

A recent McKinsey Global Institute report (MGI, 2020, p. 59ff.) presents an analysis of the potential for value chains to shift across borders over the next five years. Taking a global perspective, the analysis includes reshoring to the EU but does not discuss this exclusively. The assessment is based on economic and political factors that drive reshoring processes. The eight economic variables include (i) geographic shifts that are already unfolding (i.e. shifting trade and market shares); (ii) high capital intensity and economies of scale that make geographic shifts more expensive and thus less likely; (iii) high knowledge intensity and specialised supplier ecosystems that impede geographic shifts; (iv) the access to resources that make it difficult to shift location for resource-intensive GVCs; (v) demand growth and strategies to locate near consumer markets that drive locational shifts in certain instances; (vi) high product complexity and low substitutability of inputs that reduce the possibilities for moving production or sourcing; (vii) regionalisation of value chains near major consumer markets to decrease lead times and respond more quickly to buyer/consumer demands; and (viii) low trade intensity due to product characteristics (e.g., perishable or extremely heavy products) that limit geographical shifts.

The three political variables include (i) national security concerns that could lead governments to intervene in value chains that are relevant for the industrial base and safeguarding technologies with dual-use (military and civilian) character (e.g., semiconductors and communication equipment); (ii) national competitiveness concerns that may trigger governments to implement industrial policies aiming to capture leading shares in emerging technologies (e.g., quantum computing, artificial intelligence, renewable energy and electric vehicles); and (iii) self-sufficiency concerns, in particular in the context of COVID-19, highlighting the need for security of supply in various areas such as food, pharmaceuticals and medical equipment.

**Figure 7:** The potential for value chains to shift across borders over the next five years depends on economic and non-economic factors

Value chain	Feasibility of geographic shift		Value of exports with shift feasibility (annual exports) <sup>1</sup>		Total exports, 2018, \$ billion	Drivers of economic shift feasibility				
	Economic factors	Non-economic factors <sup>2</sup>	Range, \$ billion	Share of value chain exports, %		Top 3 exporter share change, 2015-18, pp	Capital intensity, <sup>3</sup> %	Knowledge intensity, <sup>4</sup> %	Product complexity <sup>5</sup>	Intra regional trade, <sup>6</sup> %
Global innovations	Chemicals	●	86-172	5-11	1,584	-1.4	72	26	5	57
	Pharmaceuticals	●	236-377	38-60	626	0	58	41	5	40
	Aerospace	●	82-110	25-33	333	-2.9	53	40	5	34
	Automotive	●	261-349	15-20	1,730	-1.6	51	16	5	60
	Transportation equipment	●	60-89	29-43	209	0	48	18	5	43
	Electrical equipment	●	213-319	23-34	928	-2.5	43	23	5	54
	Machinery and equipment	●	271-362	19-25	1,455	-2.2	36	19	6	50
	Computers and electronics	●	165-247	23-35	708	-1.9	47	57	5	53
	Communication equipment	●	227-363	34-54	673	9.5	51	45	5	46
	Semiconductors and components	●	92-184	9-19	995	10.5	62	39	5	81
	Medical devices	●	100-120	37-45	268	0.1	47	29	5	40
Labor intensive	Furniture	●	37-74	22-45	164	-5.7	40	15	4	55
	Textiles	●	67-134	23-45	297	-3.2	34	15	4	55
	Apparel	●	246-393	36-57	688	-8.1	30	18	3	43
Regional processing	Fabricated metal products	●	94-141	21-32	440	-3.5	33	16	5	57
	Rubber and plastic	●	97-145	20-30	488	-2.7	40	16	5	60
	Food and beverage	●	63-125	5-11	1,149	-1.1	57	14	4	56
	Glass, cement, and ceramics	●	22-45	11-21	209	-4.5	48	15	5	57
Resource intensive	Agriculture	●	112-149	20-26	568	0.4	24	10	4	47
	Wooden products	●	8-17	5-11	155	0.9	43	11	4	57
	Basic metal	●	77-153	6-12	1,250	-3.6	54	16	4	51
	Petroleum products	●	212-423	9-18	2,414	1.3	81	32	3	30
	Mining	●	29-57	6-13	452	3.8	72	16	3	49
	<b>Total</b>		<b>2,900</b>	<b>16</b>						
		<b>Low High</b>	<b>4,600</b>	<b>26</b>						

1. Low-end sizing – global imports from outside importing country's region average of economic and noneconomic feasibility. High-end sizing – global imports from outside importing country's region maximum of economic and noneconomic feasibility. 2. Noneconomic factors take into account goods deemed essential or targeted for national security or economic competitiveness considerations, based on proposed and enacted government policies and definitions of essential goods. 3. Amount of capital compensation as a share of gross output. 4. Defined as share of labor with a tertiary education. 5. Product Complexity Index measures the relative substitutability of production across sites of products in value chain. 6. Percent of total trade that takes place within same region as its importer. 7. Dependent on access to resources that are geographically determined.

Source: Federal Reserve Bank of St. Louis; Observatory of Economic Complexity; UN Comtrade; US Bureau of Economic Analysis; US Bureau of Labor Statistics; World Input-Output Database; McKinsey Global Institute analysis

Source: MGI, 2020, p. 62

The report distinguishes four categories of value chains: global innovations, labour-intensive chains, regional processing, and resource-intensive chains. Individual industries are assigned to these categories according to their characteristics. Overall, and based on the above-discussed variables, the analysis (Figure 7) highlights that value chains in the global innovations category are the most relevant for reshoring to the EU, even though the feasibility of geographic shifts with regard to economic and political factors differs. For economic reasons, transportation equipment, electrical equipment, and computers and electronics are sectors with a higher feasibility for geographic shifts. Pharmaceuticals, aerospace, automotive, communication equipment, semiconductors, and medical devices are also more likely to shift, but rather as a result of political than economic reasons. In addition, labour-intensive and regional processing GVCs may geographically shift for economic reasons, but these shifts are unlikely to affect the EU. Textiles and apparel, for example, may relocate from China to South-East Asian countries in the context of rising wages in China. The relocation of resource-intensive GVCs is rather unlikely given the required access to resources.

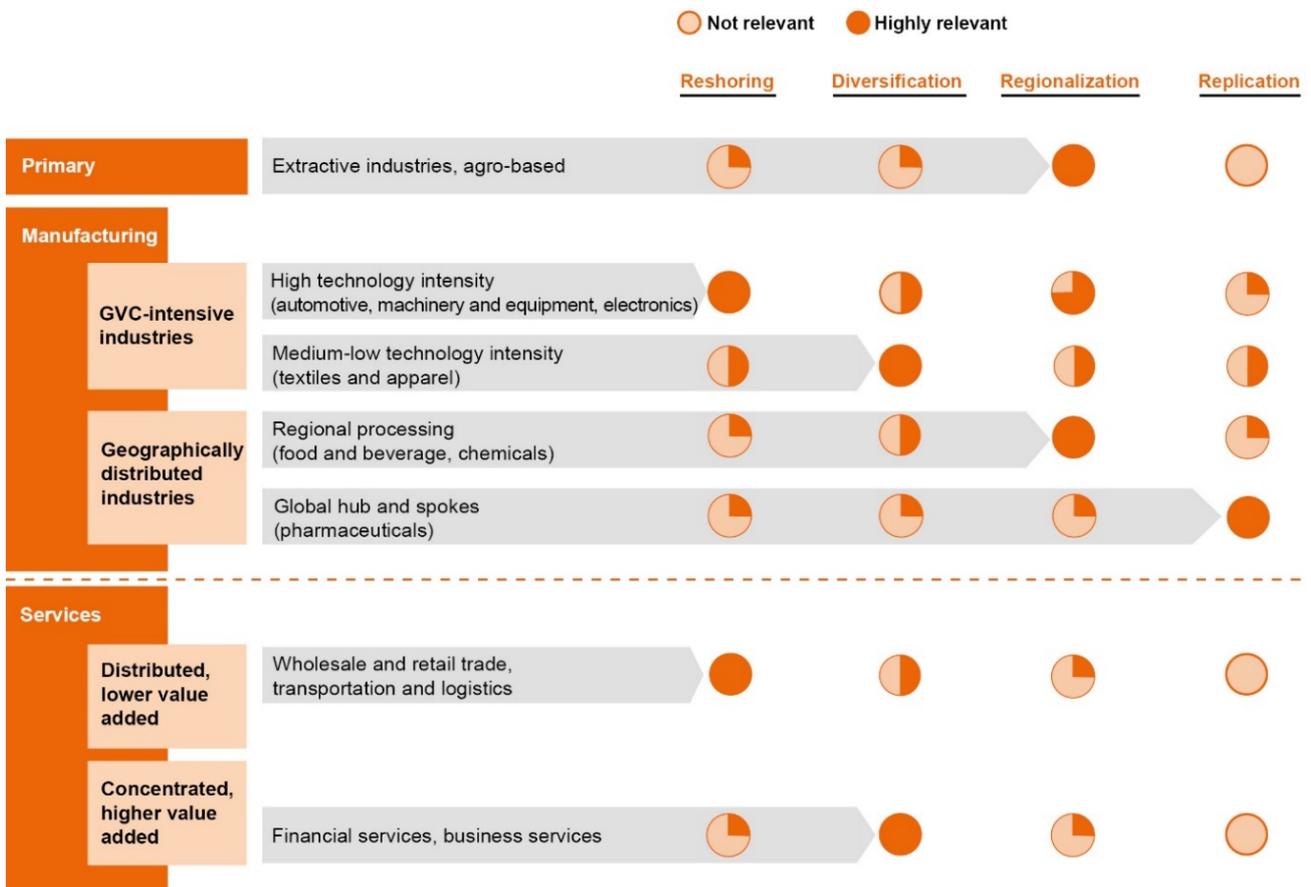
The recent World Investment Report (UNCTAD, 2020b) identifies three megatrends (technological change and new industrial revolution, shifting global economic governance, and sustainability) that will affect today’s GVCs in different ways. The report then categorises the length and geographic distribution of different GVCs (Figure 8), creating four GVC categories (primary industries, GVC-intensive, geographically distributed, services industries connected to GVCs), arguing that these are affected differently by the megatrends described above. Further, the report differentiates four development trajectories for GVCs: (i) reshoring (shorter and less fragmented GVCs, driven, for example, by increasing automation and protectionism); (ii) diversification (increased fragmentation of GVCs, driven, for example, by digitalisation and servicification processes); (iii) regionalisation (shorter but highly fragmented GVCs, driven, for example, by sustainability considerations or regional integration); and (iv) replication (shorter and less fragmented ‘replicated’ GVCs, despite higher geographic distribution of activities, driven, for example, by distributed manufacturing strategies or technologies such as 3D printing). The report argues that the main drivers for reshoring are automation processes and robotics as well as governmental policies pushing for greater self-reliance. This explains why high-tech and GVC-intensive industries (automotive, machinery and equipment, electronics) are those most likely to reshore (Figure 9).

**Figure 8:** Length and geographic distribution of international production and key archetypes

Archetypal international production configurations				
Archetypes	Select industries	Length/fragmentation	Geographical distribution of value added	Governance (FDI intensity)
<b>Primary industries</b>				
Capital intensive	Extractive	Short	Concentrated	High
Less capital intensive	Agro-based	Short	Distributed	Low
<b>GVC-intensive industries</b>				
High-tech	Automotive, machinery and equipment, electronics	Long/fragmented	Concentrated	Low
Low-tech	Textiles and apparel	Long/fragmented	Distributed	Low
<b>Geographically distributed industries</b>				
Regional processing	Chemicals, food and beverage	Long/fragmented	Distributed	High
Global hub and spokes	Pharmaceuticals	Short	Distributed	High
<b>Services industries connected to GVCs</b>				
Lower value added	Transport and logistics, wholesale and retail	Short	Distributed	Low
Higher value added	Financial services, business services	Short	Concentrated	High

Source: UNCTAD, 2020b, p. 137

**Figure 9:** Relevance of development trajectory, by industry

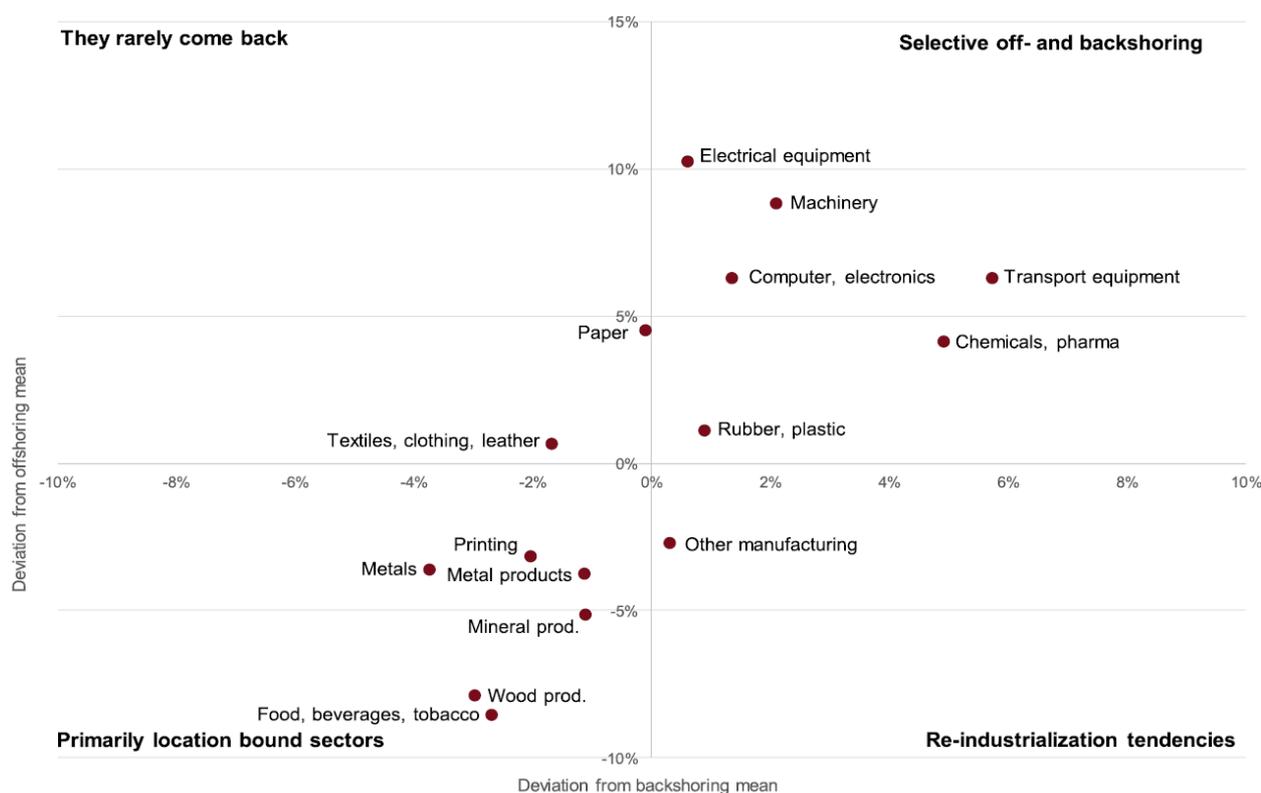


Source: own elaboration based on UNCTAD, 2020b, p. 166

In addition to the above-discussed reports that focus on future trajectories, the empirical literature on reshoring also presents sector-specific assessments based on an analysis of reshoring processes over the last decade. The comparative analyses of Dachs and Kinkel (2013), Dachs and Zanker (2014) and Dachs et al. (2019) discussed above, underline some tendencies with regard to the different sectors' propensity to reshore (including intra-EU reshoring in these instances). The sectors with the highest propensity to reshore (selective off- and backshoring) include electrical equipment, electronics/computer, machinery, motor vehicles/transport equipment, communication equipment and pharmaceuticals (Figure 10).

This overview has shown a certain degree of agreement in the literature that high-tech intensive industries are more likely to backshore to the EU, either for economic or for political reasons. There seems to be some agreement that economic factors tend to drive companies in the machinery, electrical and transportation equipment, and potentially also the electronic sectors towards reshoring to the EU. Other sectors, such as medical products, chemicals, pharmaceuticals, aerospace, communication, electronics, automotive and semiconductors, tend rather to be reshored on account of political motivations. The overall conclusion that specific sectors are more likely to reshore should be interpreted with caution, since the assessment on the complex subject is based on a broad set of different variables. What is more, many of these sectors are highly heterogeneous. For example, reshoring within the computer/electronics sector is likely to happen in specific niches such as measuring technology, and it is not relevant for computer manufacturing on a significant scale. Similarly, the assessment of the World Investment Report 2020 (UNCTAD, 2020b) that the pharmaceutical GVCs are likely to 'replicate' instead of 'reshore' also does not sufficiently take into account the complexity of the pharmaceutical GVC, which is comprised of three different GVCs, each exhibiting a different propensity to reshore (see section 4.3).

**Figure 10:** Sector-specific propensity to reshore



Source: Dachs et al., 2019

Note: Data refer to EMS 2015 (2013 to mid-2015), n=2 450

### 4.3 Case Study 1: Pharmaceuticals <sup>16</sup>

The COVID-19 crisis has highlighted the (potential) vulnerabilities of pharmaceutical supply-chains, in particular, due to pronounced EU import dependencies for various critical medical inputs and the threat of limitations in cross-border trade (especially export bans) in the context of sudden supply shortages or demand surges. It should be noted that, other than during the initial outbreak in early 2020, when health systems and hospitals were (at least partially) overwhelmed, COVID-19-induced drug shortages in the EU have so far been relatively rare. However, COVID-19 has served to highlight the existing phenomenon of drug shortages in the EU, which have become more frequent over the last decade. The European Parliament has sought to address the problems of medicine shortages in the EU since as early as 2017.<sup>17</sup> According to a recent report prepared by the European Parliament’s Committee on the Environment, Public Health and Food Safety, it is estimated that the number of shortages increased 20-fold between 2000 and 2018, and have increased 12-fold since 2008 (EP, 2020a). In addition, a new OECD study on shortage notifications in 14 OECD countries between 2017 and 2019 showed that the number of notifications of expected or actual shortages increased by more than 60 % (OECD, forthcoming). The drugs affected by these shortages include a large variety of products (including cancer treatments, antibiotics, vaccines, anaesthetics and medication for hypertension, heart disease and disorders of the nervous system) which is why the reasons for these shortages also differ. Shortages may result from manufacturing problems, quality issues, unexpected spikes in demand, parallel imports/exports and more (EP, 2020a). However, it is now increasingly acknowledged that the consolidation of the industry and outsourcing

<sup>16</sup> The case study is partly based on Grumiller et al. (2021)

<sup>17</sup> See [https://www.europarl.europa.eu/doceo/document/TA-8-2017-0061\\_EN.html](https://www.europarl.europa.eu/doceo/document/TA-8-2017-0061_EN.html) (04.11.2020)

processes over the last decades, in particular with regard to low-value generic products, has added to the problem (EP, 2020a; Council of the EU, 2019).

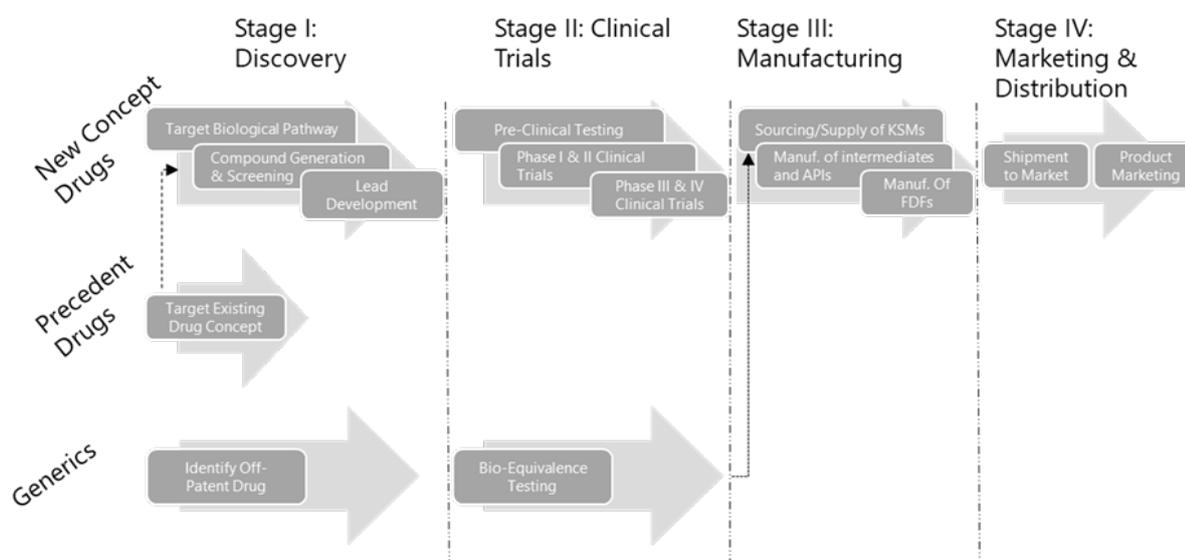
### The pharmaceutical GVC and the EU’s competitive position

The pharmaceutical GVC can be divided into four key stages: (i) the discovery of new drugs through R&D; (ii) the approval of new drugs through clinical trials; (iii) the manufacturing of approved drugs, including (iii.a) the supply/sourcing of key starting materials (KSM), (iii.b) the production of intermediates and APIs, and (iii.c) the production of the finished dosage forms (FDF) (e.g., pills or capsules) through the combination of APIs with excipients; and (iv) the marketing and distribution of drugs (cf. Kedron and Bagchi-Sen, 2012; Zeller and Van-Hametner, 2018).

Within the pharmaceutical GVC, three types of drugs with different development paths can be distinguished (Figure 11): new concept, preceded, and generic/biosimilar drugs (Wadhwa et al., 2008, p. 6; Kedron and Bagchi-Sen, 2012, p. 817). The former two are associated with branded products and pursued by originator manufacturers. New concept development represents a first attempt to treat chemical and biological reactions that cure diseases and is associated with the highest cost. Precedented development builds on existing drug concepts and requires less innovation and thus lower investment. The generic development path — regardless if low or high-quality generics are produced — skips the first two stages of product development and incurs the lowest cost (Kedron and Bagchi-Sen, 2012, p. 817).

The current structure and dynamics of the pharmaceutical GVC need to be understood from a historical perspective. The pharmaceutical industry is a comparatively young industry and emerged as a R&D intensive manufacturing industry only during the second half of the 20th century, building on new discoveries during and after the Second World War (Haakonsson, 2009; Breitenbach and Fischer, 2013, p. 6). In the last decades, the industry was fundamentally transformed through concentration and outsourcing processes expedited by: (i) the changing international institutional framework, in particular the establishment of the WTO and the agreement on trade-related aspects of intellectual property rights (TRIPS); (ii) price pressure on generic products due to (ii.a) increasing competition from China and India, benefitting from scale effects, lower wages, lower environmental regulations and industrial policy support, and (ii.b) buyers in the EU focusing on price and quality, disregarding other criteria such as supply security or environmental and labour standards; (iii) financialisation processes and increasing shareholder orientation, elevating profitability requirements in the industry.

**Figure 11:** Three development paths of pharmaceutical products

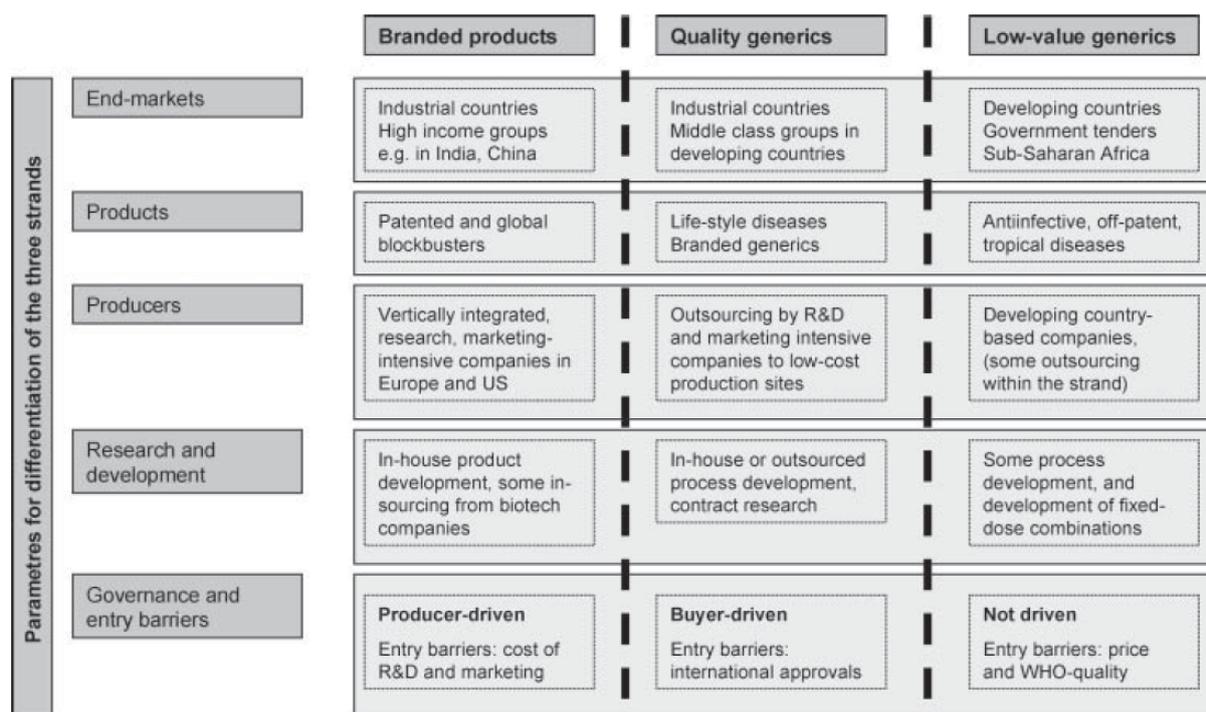


Source: Own elaboration based on Kedron/Bagchi-Sen, 2012, p. 818

As a result, the pharmaceutical GVC today is characterised by three different strands (Figure 12): (i) a producer-driven GVC for branded products, which means that this GVC is dominated by vertically integrated EU and US TNCs. These firms produce within OECD countries and sell to OECD countries, as well as to other high-income groups in (semi-)peripheral countries (although the increasing role of small biotech firms and start-ups in drug development, as well as a large service industry in testing, stands in contrast to this overall structure); (ii) a buyer-driven GVC for quality generics, characterised by decentralised, globally-dispersed production networks, coordinated by lead firms, with control over activities that add 'value' to products (e.g., design, branding), but often outsource all or most of the manufacturing process to a global network of suppliers; and (iii) and a 'non-driven' (global) value chain, dominated by national companies for low-value generics (Haakonsson, 2009).

The growth and globalisation of the pharmaceutical GVC and the particular importance of branded products in terms of value is also reflected in trade data. The global trade value of FDF pharmaceutical products (HS Code 3004) increased almost by a factor of 10 over the last three decades, from USD 39.4 billion in 1995 to USD 352.9 billion in 2019 (UN Comtrade, 2020).

**Figure 12:** A typology of pharmaceutical GVCs



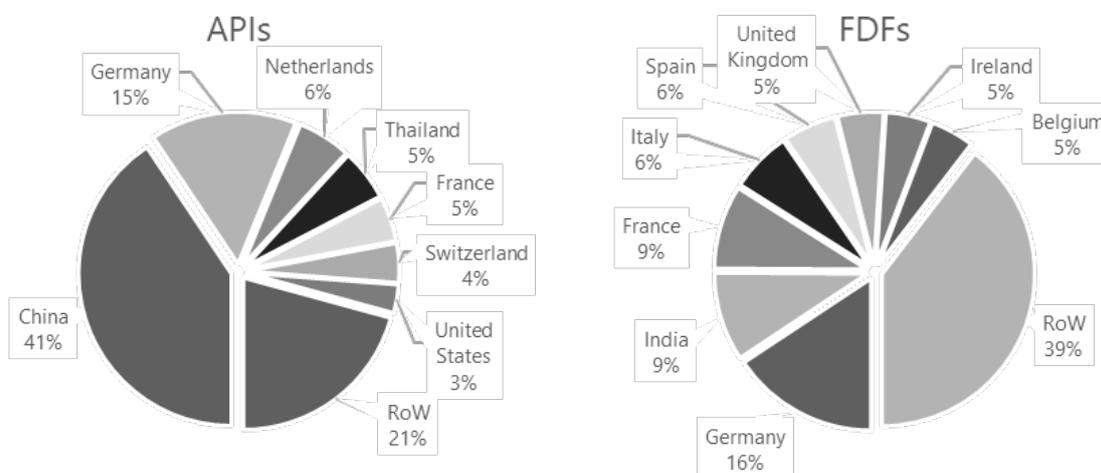
Source: Haakonsson, 2009, p. 83

The outsourcing processes also significantly changed the EU's integration in pharmaceutical GVCs, increasing its import dependency for a variety of low-value, low-complexity and off-patent APIs. In 2019, the pharmaceutical industry in the EU-27 had an annual production value of roughly EUR 275 billion (~2% of EU GDP), employing almost 800 000 people (EFPIA, 2020). Various EU countries such as Germany, France, Italy and others remain key players in global pharmaceutical trade (Figure 13).<sup>18</sup> This is because the EU's pharmaceutical industry focuses on producing high-value and on-patent products for local consumption and exports, and generally imports low-value and off-patent API and/or FDF products for further processing, local/regional consumption, or export. In 2019, the EU imported EUR 11.1 billion and exported EUR 7.4 billion APIs, generating a trade deficit of EUR 3.7 billion for APIs. The API trade deficit is particularly

<sup>18</sup> Roughly one-third of global FDF pharmaceutical trade constitutes intra-EU trade (UN Comtrade, 2020).

pronounced for hormones, prostaglandins, thromboxanes and leukotrienes (HS code 2937; EUR 2.3 billion) and antibiotics (HS code 2941; EUR 1.7 billion) (Eurostat, 2020a). For APIs, France, Germany, Spain and Italy have the largest number of manufacturers in the EU (MundiCare, 2020). The EU, in particular, imports high volume APIs from Asia, while maintaining production capacities for smaller volume and complex APIs (Figure 14). For FDFs, the EU imported EUR 42.2 billion and exported EUR 118.3 billion, generating a significant trade surplus (EUR 76.1 billion) against the rest of the world (Eurostat, 2020a).

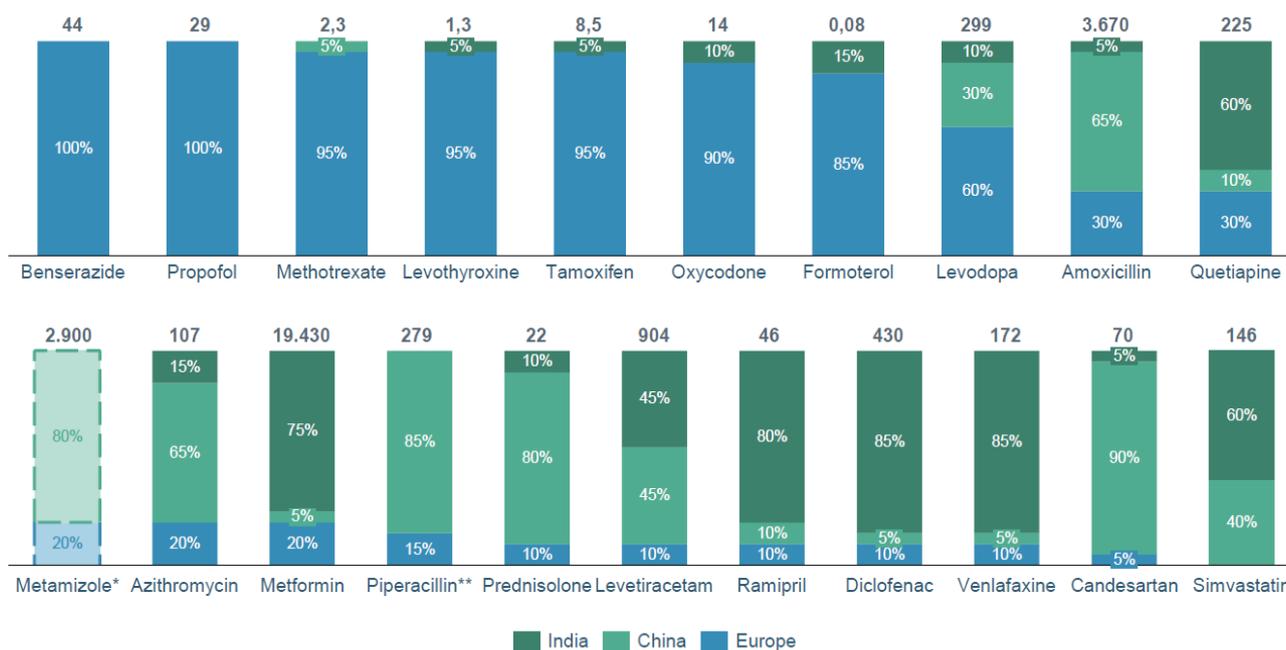
**Figure 13:** Global trade shares of APIs and FDFs by volume (2019)



Source: UN Comtrade, 2020 (WITS)

Note: Data include intra-EU-trade. RoW=Rest of the World.

**Figure 14:** Estimated share of supply for European demand of APIs by region



\*) Estimation, Data basis limited; \*\*) API mainly in combination with Tazobactam (exclusively produced in Asia).

Source: MundiCare, 2020

Note: Above each bar represents the estimated European demand in tons.

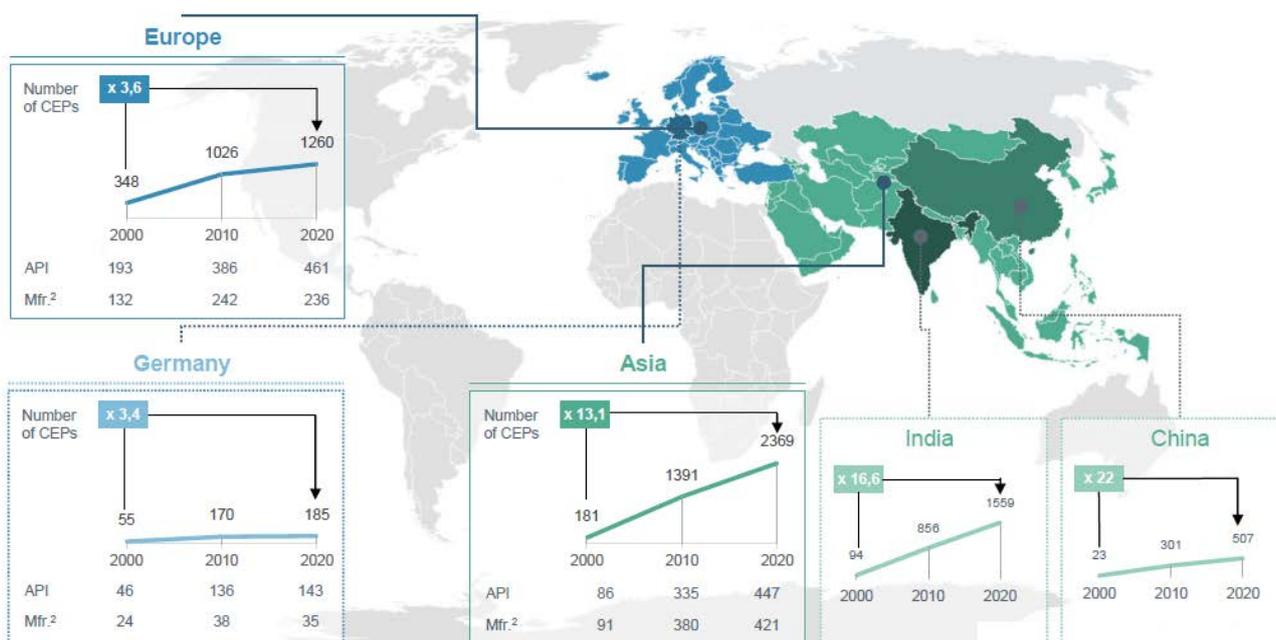
The crucial and increasing role of China and India in the pharmaceutical generics GVC is also reflected in the trade data, in particular since the mid-2000s. Today, China is the key global source of APIs for the global pharmaceutical industry. The trade value of these inputs amounted to EUR 44.1 billion<sup>19</sup> in 2019, and globally more than 40 % of these inputs by volume are sourced from China (HS codes 2936 to 2941) (Figure 13). Similarly, India is a key global supplier of low-value-generics and accounts for 9% of global exports of dosified medicines in terms of volume (compared to 4% in value terms, in 2019) (Figure 13). Excluding intra-EU trade, India's share in world trade by volume increased to 22 %, highlighting its dominant position in low-value generics trade (*ibid.*).

The growing importance of both China and India as key global suppliers of APIs and FDFs in the generics pharmaceutical GVC played a major part in the changing role of the EU in pharmaceutical manufacturing. This change is reflected in the growing number of APIs with a Certificate of Suitability of Monographs of the European Pharmacopoeia (CEP) — that is, APIs that comply with European regulatory requirements — in Asia from 181 in the year 2000 to 2 369 in 2020 (Figure 15). In Europe, during the same period, the number of CEPs only increased from 348 to 1 260. Similarly, the number of manufacturers increased from 91 to 421 in Asia, yet only from 132 to 236 in Europe. In general, the share of Asian CEP holders for APIs increases with the production volume of APIs (*cf. MundiCare, 2020*).

Global production of APIs is highly regionally-concentrated in just a few Indian and Chinese provinces (especially Telangana, Maharashtra, Zhejiang, Jiangsu, Shandong) and industrial parks. Furthermore, there are only a few CEPs, and therefore manufacturers, worldwide for more than half of APIs (*ibid.*). There are, for example, only four suppliers of the benzathine penicillin G (BPG) API globally, and there have been repeated shortages of BPG (e.g., during syphilis outbreaks), in particular in the global semi-periphery (Cogan, Karrar and Iyer, 2018). The combination of Piperacillin/Tazobactam, in addition, is only produced in Asia, and shortages occurred globally and in the EU in 2016/17 due to an explosion at a key global manufacturing site. In contrast, there is a comparatively large number of API-producing companies for Paracetamol, but global production is essentially limited to China and India due to the availability of a product-specific supplier-ecosystem. Moreover, almost all API producers outside China are dependent on imports of intermediate inputs from a few companies in China (para-aminophenol). In light of the increasing enforcement of environmental regulations, labour regulations regarding working conditions, and increasing wages, particularly in China, outsourcing of pharmaceutical production to countries such as Vietnam, Malaysia, Mongolia and Indonesia has either already started or is currently under consideration.

<sup>19</sup> Converted data (USD 39.4 billion). Exchange rate (1.1195) based on ECB (2020).

**Figure 15:** Overview of CEPs, APIs, and manufacturers by region (2000–2020)



<sup>1</sup>) Number of all valid CEPs in the respective calendar year for the APIs under consideration (expired / withdrawn CEPs are already excluded)

<sup>2</sup>) Mfr. = Manufacturer

Source: MundiCare, 2020

### Potential for reshoring and alternative options

The increasing shortage of medicines has also caught the attention of policymakers on EU and national levels. As a result, a task force on the Availability of Authorised Medicines for Human and Veterinary use (TF AAM) led by the European Medicines Agency (EMA) and the Heads of Medicines Agency (HMA) was set up in 2016 to investigate shortages and supply chain disruptions. The main goal of this task force is to reduce supply shortages, in particular through improved EU coordination. In addition, with the EU4Health Programme, part of the Next Generation EU recovery plan, the EU also aims to improve the availability of medicines through the development of a European monitoring, reporting and notifying system (EC, 2020a). Furthermore, Members of the European Parliament have called for financial incentives to increase API production in the EU and create an EU contingency reserve of medicines with strategic importance (EP, 2020b).

The recently published (November 2020) Pharmaceutical Strategy for Europe by the EC (2020b) encompasses four strategic pillars: (i) addressing unmet needs of patients; (ii) improving access to affordable medicines for patients; (iii) promoting a competitive and innovative European pharmaceutical industry; and (iv) enhancing the resilience of the pharmaceutical supply chains. The latter aims to build the EU's *open strategic autonomy* in the pharmaceutical sector by diversifying production and supply chains, promoting strategic stockpiling, and increasing production and investment in Europe.

This flagship initiative on open strategic autonomy includes a revision of the pharmaceutical legislation by 2022 to enhance the security of supply through earlier notification of shortages, stricter obligations for supply and transparency, enhanced transparency of stocks and improved EU coordination and mechanisms to manage and avoid shortages. The strategy also initiates a *structured dialogue* with the actors in the pharmaceutical GVC, including manufacturers, public authorities, research communities, Non-Governmental Organisations (NGOs), etc., in order to assess the vulnerabilities of the GVC and to discuss other potential options for improving supply security, such as reshoring. The strategy, thus, remains vague with regard to the promotion of reshoring in the EU pharmaceutical sector.

In general, the discussion on reshoring and increasing the resilience of pharmaceutical supply chains is particularly relevant to the generics pharmaceutical GVC. This GVC is exposed to greater levels of vulnerability than on-patent or branded products, because it is subject to a higher degree of global decentralisation and concentration of production. Another reason is the EU dependency on API (and to a lower degree FDF) imports, and the associated risk of API/FDF shortages in the event of disturbances in cross-border trade or demand surges. Indeed, many of these generic APIs, which include various antibiotics and analgesics, may be characterised (depending on the definition) as 'critical' or 'essential'. Given the high priority of many generic pharmaceuticals and potential cross-border disturbances in times of crisis, such as in a pandemic, the EU may not only aim to ensure the security of supply through stockpiling, and by increasing the resilience of the GVC through regulations for firms (e.g., on transparency, inventory or sourcing practices), but also by reshoring a variety of such critical products.

The main challenge for reshoring generic APIs to the EU is related to their limited profitability, owing to: (i) international competition and cost-pressures related to large scales of production, low wages, and low environmental regulations; (ii) buyers in the EU (health insurance funds, hospitals, etc.) focusing on price and quality and not (or only to a very limited extent) on other criteria such as security of supply or environmental and labour standards; and (iii) profitability requirements in the context of the large pharmaceutical companies' shareholder-value orientation. Promoting API, and to a lesser extent FDF, production of off-patent and generic pharmaceuticals in the EU would, thus, require a mix of policies, including industrial policy measures such as subsidies and tax incentives, but also regulatory measures.

In particular, changes in buyer requirements across the EU in terms of price, quality, supply chain resilience and sustainability standards, would allow for higher prices, which would, in turn, help to ensure resilient supply chains and, thus, more regional production (potentially promoting both reshoring and nearshoring processes). Stricter sustainability standards would also impede corporate strategies that aim to enhance competitiveness by outsourcing from China or India to countries with lower labour and environmental standards, such as Vietnam or Mongolia (for exports to the EU). The inclusion of sustainability standards would, thus, also increase the competitiveness of the EU industry for critical low-value products, potentially reducing the need for financial incentives. However, buyers including sustainability and supply-chain resilience standards into their purchasing requirements would need to account for a sufficiently large market share to create the necessary change in company strategy. Furthermore, the differences between health systems in the EU and the variety of different actors involved in buying decisions (especially hospitals and health funds) currently make the implementation of such a strategy difficult. The higher prices of pharmaceuticals would also result in higher expenditures for buyers and a corresponding increase in health insurance costs.

Given the importance of economies of scale and potential linkages in the manufacturing of different APIs (e.g., regarding required inputs from the chemical industry), and the large amount of potentially critical pharmaceuticals, reshoring strategies in the pharmaceutical sector require EU-wide coordination. For example, vertically-integrated production of Paracetamol (and similar pharmaceuticals produced from benzene) in the EU would also require to support the rebuilding of a complex supplier-ecosystem, given that many inputs are not produced in the EU on a significant scale anymore. In addition, promoting reshoring through industrial policy should target specific key/critical pharmaceuticals (and potentially APIs with production linkages), given that it is unlikely and costly to reshore/nearshore the production of 'all' potentially critical pharmaceuticals. Thus, a systemic approach needs to be found to increase the resilience of supply chains. Such an approach should incorporate a policy-mix of promoting reshoring, together with other measures, including stockpiling and market regulation.

For pharmaceuticals, various stockpiling models are possible. The basic trade-off involved in stockpiling is between security of supply and cost-effectiveness. The more comprehensive the stocks of pharmaceutical products, the higher the costs of storage and associated transactions. Given its higher bargaining power,

more centralised stockpiling will lead to lower sourcing costs for drugs, while it will increase logistics costs for management and distribution. For larger-scale stockpiling programs, coordination at the EU level will be necessary, while smaller-scale storage models may be effectively organised at the national level.

In this context, there are at least two key issues to consider. One key issue relates to the type of products to be stored. Should it be APIs or FDFs, or a mix of both? Storing APIs may be more cost-effective but is conditional upon the technical feasibility and the availability of production capacities in the EU for processing APIs into FDFs. If no production capacities exist in the EU, the storage of imported FDFs may be preferable. Another issue relates to the governance model for stockpiling. Should stocks be managed by a public entity or by private operators, that is, manufacturers or traders? The first option would involve large upfront investments, the second option would be based on existing structures, but require a regulatory framework that stipulates precise storage obligations for private operators and possibly be complemented by financial compensation.

#### 4.4 Case Study 2: Medical products<sup>20</sup>

Before the COVID-19 pandemic, the production and supply-chains of medical products did not attract much attention, largely because markets for most of these products worked smoothly and delays or shortages were the exception rather than the rule. This changed in the first quarter of 2020 when demand surges revealed the difficulty in providing a sufficient supply of critical medical products such as examination gloves, respirators and ventilators during the COVID-19 pandemic. For this reason, debates on increasing the resilience and reshoring of critical medical product GVCs have regained importance in the EU, the US and many other countries.

##### **The medical products GVC and the EU's competitive position**

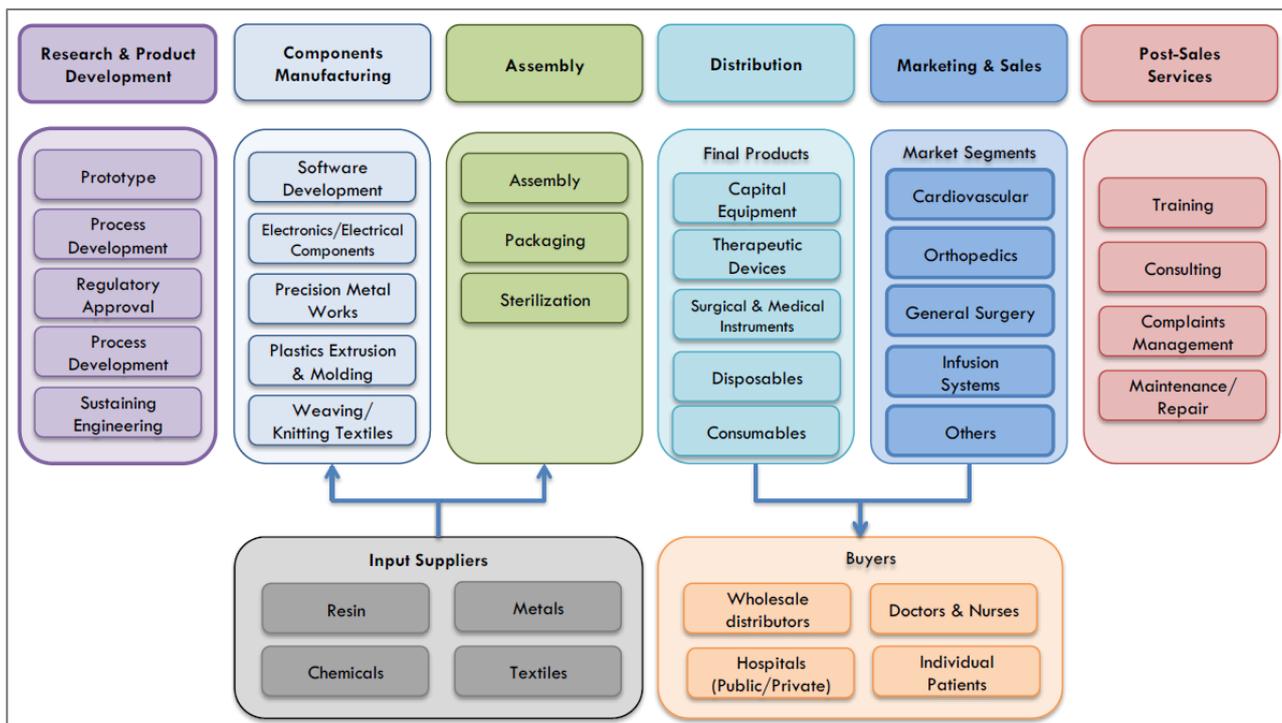
Medical products, commonly understood to refer to medical equipment rather than pharmaceuticals, cover a wide range of product categories (Hamrick and Bamber, 2019). On the one end of the spectrum, they include simple products such as bandages, syringes or PPE. PPE is defined as 'equipment worn to minimise exposure to hazards that cause serious workplace injuries and illnesses',<sup>21</sup> and includes items such as examination gloves, facemasks, coveralls or safety glasses. The other end of the spectrum includes technically complex equipment such as MRI scanners or ventilators, referred to as medical devices in order to distinguish them from PPE-like products. These sophisticated capital goods can be utilised for several years and represent large, long-term investments. Generalising statements about such diverse categories as 'medical products' are, therefore, often not meaningful. When assessing GVC dynamics and policy-options, it is important to make appropriate distinctions between different types of medical products.

Figure 16 illustrates the main elements of the GVC of medical products (in a broad sense): (i) research and product development; (ii) components manufacturing; (iii) assembly; (iv) distribution; (v) marketing and sales; and (vi) post-sales services (Hamrick and Bamber, 2019). By the logic of the smile curve, R&D represents the highest value-added stage of the value chain, whereas, in most instances, manufacturing delivers the lowest value-added. The R&D process of medical devices is complex and time-intensive because each element and functionality of a product must receive regulatory approval by the authorities in the relevant markets. Investment in R&D is much more important for complex medical devices as compared to PPE. Typically, R&D departments are located in high-income economies providing the necessary human capital and the benefit of knowledge spillovers from universities or related companies.

<sup>20</sup> The case study is partly based on Grumiller et al. (2021)

<sup>21</sup> See <https://www.osha.gov/personal-protective-equipment> (04.11.2020)

**Figure 16:** GVC of medical devices



Source: Hamrick and Bamber, 2019

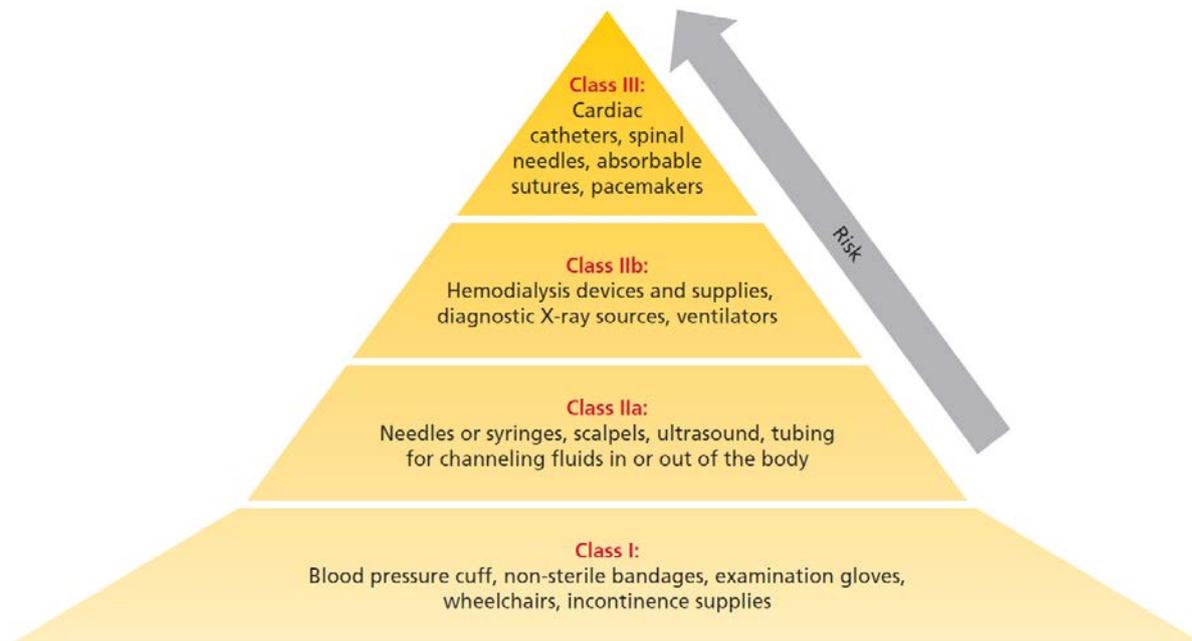
Depending on the type of product, the production process may include advanced IT elements such as software development or more general industrial competencies such as textile production. Cost, quality, regulatory factors, lead-time and the protection of intellectual property and knowledge are the main parameters in the manufacturing of medical devices (Brocca, D’souza and Sisko, 2017). After-sales services such as training and maintenance are also crucial for complex, technologically advanced capital equipment. These are not carried out by hospital staff but by external service teams affiliated with the manufacturer.

The value chains of medical devices are producer-driven; that is, the producers themselves are the powerful players (Hamrick and Bamber, 2019). They have the competence and the resources to organise global production networks and to make sure that the devices adhere to a complex set of public and private standards. Standards aim to ensure the safety and quality of medical products, and are influential on how firms develop, design, produce and distribute their products. The rigour of the standards increases with the potential hazards associated with the malfunctioning of the respective medical product. Figure 17 illustrates the different classes of regulation of medical devices in the EU.<sup>22</sup>

In regard to the value chain of PPE, the governance structure is less clear-cut because the power of buyers is higher due to relatively low technological competencies and intensive price competition. In addition, PPE GVCs are less innovative and highly cost-driven. Perhaps the most appropriate characterisation of the PPE chain is that it is market-driven, that is, the transactions are not very complex, can be easily codified, and the suppliers have the capabilities to produce PPE without significant input from the buyers. Even though regulation for PPE is less strict than for medical devices, regulation issues remain highly relevant.

<sup>22</sup> There will be some changes to this scheme with the new EU medical device regulation 2017/745, which comes into force in 2021.

**Figure 17:** Regulation of medical devices in the EU according to the level of risk



Source: Harrington, 2015

Compared to other industries, the process of outsourcing and offshoring medical products to lower-cost countries has been relatively slow because of the need to deliver high and consistent quality in line with demanding regulatory frameworks (Bamber, Fernandez-Stark and Taglioni, 2020) and has mainly been limited to low-tech medical goods such as PPE. While medical device companies have traditionally been vertically integrated to protect intellectual property, this has changed over the last decades, and outsourcing to contract manufacturers is on the rise. The same holds true for just-in-time production and single-sourcing (i.e., buying inputs from one supplier only), both of which are strategies thought to increase efficiency and reduce costs (Ebel et al., 2013; Park et al., 2020). Lead firms in the medical device value chain have also increasingly limited their production to a handful of locations in order to monitor production processes closely. One important reason for these dynamics can be attributed to mounting cost pressures from public buyers who try to cope with rising health care costs and austerity policies (Harrington, 2015; Brocca, D’souza and Sisko, 2017; van den Heuvel et al., 2018).

A small number of multinational lead firms dominate the GVC for medical devices. Each of the top 10 firms (by revenue) is located either in the US or Europe, which, together, account for more than 50% of the exports in all segments of the medical device sector. Their dominance is highest in the therapeutics market (72.6 %) but lower in the consumables segment, including for items such as bandages or dressings (59 %). Having said that, several non-OECD economies have entered the chain via offshore manufacturing, and exports from countries such as China, Malaysia, Mexico, Singapore, Costa Rica and South Korea have grown much faster than the average. In addition, there are also important product-specific regional characteristics. For example, examination gloves are almost exclusively produced in Malaysia, while facemasks are produced in a variety of different countries (although China remains the market leader in facemask production). The lead firms in the PPE chains are from both OECD and non-OECD economies and are highly diverse. For example, 3M is a major US firm with operations in 70 countries, selling more than 60 000

different products across 200 countries, including facemasks in Europe, Asia and the US.<sup>23</sup> In contrast, Malaysian-based Hartalega is a leading global producer of examination gloves with no manufacturing plants outside of Malaysia.<sup>24</sup>

The increasing role of China in the sector can be explained by the country's vast domestic market, its growing demand for medical products, and an ambitious industrial policy aimed at building up a globally competitive medical device industry, thereby reducing its import dependency. Medical devices figure prominently in the industrial policy strategy 'Made in China 2025' with the aim of increasing domestic content of advanced medical devices to 70% (Congressional Research Service, 2020). An important policy instrument has been to instruct local hospitals to buy domestically produced medical devices from Chinese firms (Collins, 2019). So far, the strategy seems to have been successful, and the country's medical device sector is experiencing a period of upgrading dynamics: once dominated by low-value-added activities, FDI projects in China are now driven by activities with high-value-added, and the exports of medium to high-tech medical devices have been exceeding low-tech exports since 2012 (Torsekar, 2018). Companies such as Mindray, founded in 1991 and located in Shenzhen, have managed to become lead firms in the GVC, and the shortages during the pandemic enabled Chinese firms to enter European markets in areas such as ventilators, a market segment from which Chinese products had previously been shunned (Kamp, 2020).

The medical product market in the EU-27, Norway, Switzerland, and the UK amounted to EUR 120 billion in 2018 (manufacturer prices), an estimated 27% of the global market share (MedTech Europe, 2020). Germany (27.1%), France (14.6%), the UK (11%), and Italy (10.1%) account for the largest market shares in Europe. Over the past ten years, the European market has grown by an average annual rate of 4.2% (ibid.). There are more than 32 000 medical product manufacturers in Europe, employing almost 730 000 people in 2020. Almost all of these medical product companies are small or medium-sized companies (95%), the majority of which employ fewer than 50 people (ibid.). The large production capacities in the EU reflect the producer-driven value chains for more complex medical products, even though the products produced in the EU also heavily rely on global imports.

The main final buyers of medical devices in the EU are public hospitals or associations of hospitals at the regional or federal level. They source complex products such as ventilators directly from the medical device producer and obtain PPE via wholesale distributors. The final buyers have only limited knowledge of the actual organisation of production processes, which limits their capacity to evaluate potential risks in the supply chain. Hospitals also recently moved towards adopting just-in-time inventories and sourcing from fewer vendors to reduce costs, negatively affecting many hospitals during the COVID-19 pandemic (Gereffi, 2020; Vecchi, Cusumano and Boyer, 2020). This, of course, mirrors the effort to introduce just-in-time production by the suppliers and illustrates the cost pressure on diverse actors in the medical device value chain.

Overall, the EU made a trade surplus of EUR 84.6 billion for medical products in 2019 (Eurostat, 2020a). Looking specifically at those medical product categories that have been of particular importance during the COVID-19 crisis<sup>25</sup> — and which would be important in the event of similar future pandemics — EU imports (excluding intra-EU trade) of medical consumables (EUR 50.4 billion), medical devices and equipment (EUR 19.6 billion) and protective garments and the like (EUR 17.7 billion) are particularly large, even though the EU has a trade surplus in most of these sub-categories as well (ibid.) (Figure 18).

The COVID-19 pandemic revealed substantial holes in the security of supply for medical products in the EU. The main factor behind insufficient supply was demand surges for medical products that were critical

<sup>23</sup> See [https://www.3m.com/3M/en\\_US/company-us/about-3m/history/](https://www.3m.com/3M/en_US/company-us/about-3m/history/) (04.11.2020)

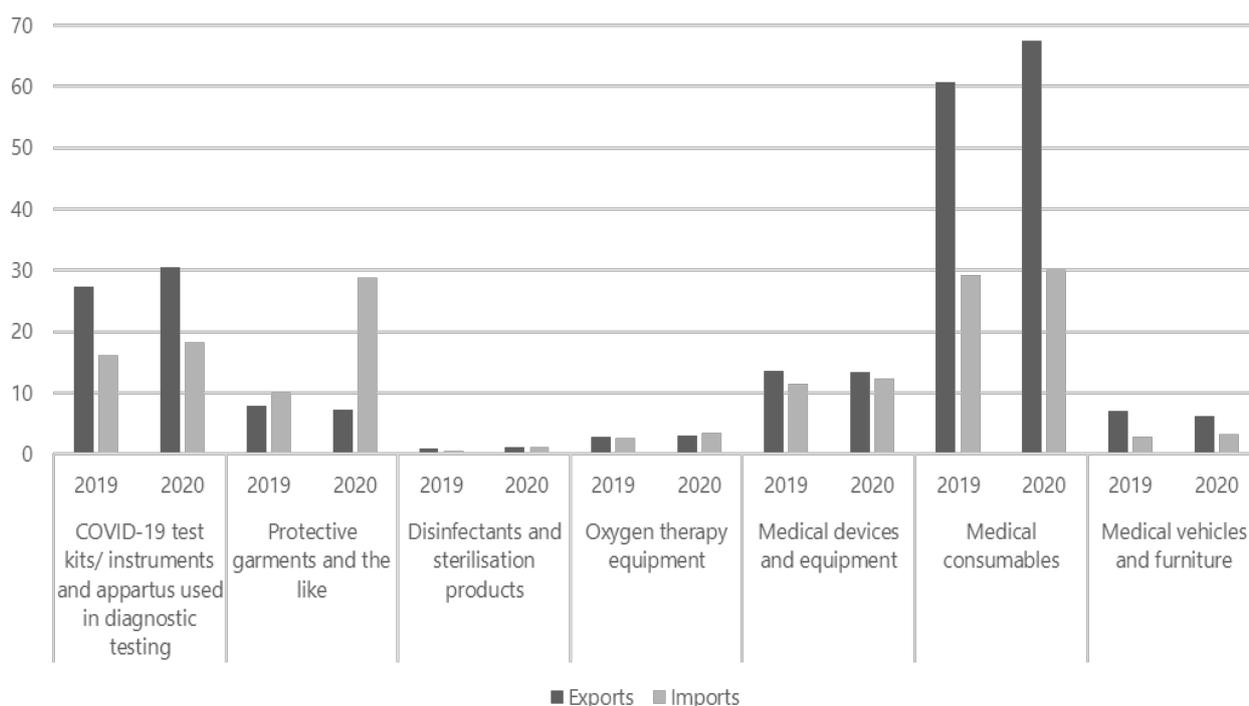
<sup>24</sup> See <https://hartalega.com.my/about-us/> (04.11.2020)

<sup>25</sup> For more details see Eurostat's HS/CN8 classification reference list for the dataset 'EU trade since 2015 of COVID-19 medical supplies', see <https://ec.europa.eu/eurostat/documents/6842948/11003521/Corona+related+products+by+categories.pdf> (15.12.2020)

during the crisis, such as examination gloves, facemasks and ventilators. For many of these products, the sudden demand surge created bottlenecks in previously well-functioning supply chains. The characteristics of these bottlenecks differed between products, highlighting potential product-specific vulnerabilities of GVCs. This was, for example, the case for examination gloves, which are mostly imported from Malaysia. While many Malaysian manufacturers operate well within their capacity, bottlenecks ensued during the first phase of the pandemic when shutdowns affected the supply of packaging. In the case of respirators, the global supply of meltblown (a special woven fabric) caused the main bottleneck. In contrast, ventilators, although produced in the EU, were subject to bottlenecks due to single-sourcing strategies and to the temporary closure of a major Asian chip producer. Because of the high specialisation and the need to source products from certified producers, switching to alternative suppliers in the short run was impossible.

Figure 18 compares EU exports and imports between the first halves of 2019 and 2020, highlighting the impact of the COVID-19 pandemic. Imports of protective garments and similar products grew by 185% (EUR 18.7 billion), an increase which can be largely attributed to the 1 462% growth in facemask imports from EUR 1.1 billion to EUR 17.2 billion, but also to increased imports of other products within this category, including single-use drapes (+229%), protective garments/coveralls made of rubber sheeting or similar textiles (+210%), or protective garments for surgical/medical use (+161%). Even though imports increased across all medical product categories, the effect was weaker in categories such as disinfectants and sterilisation products (74% or EUR 0.45 billion), oxygen therapy equipment (31% or EUR 0.8 billion), and medical devices (6% or EUR 0.74 billion) (Eurostat, 2020a).

**Figure 18:** Comparison of EU exports and imports of medical products in the first halves of 2019 and 2020, in billion EUR



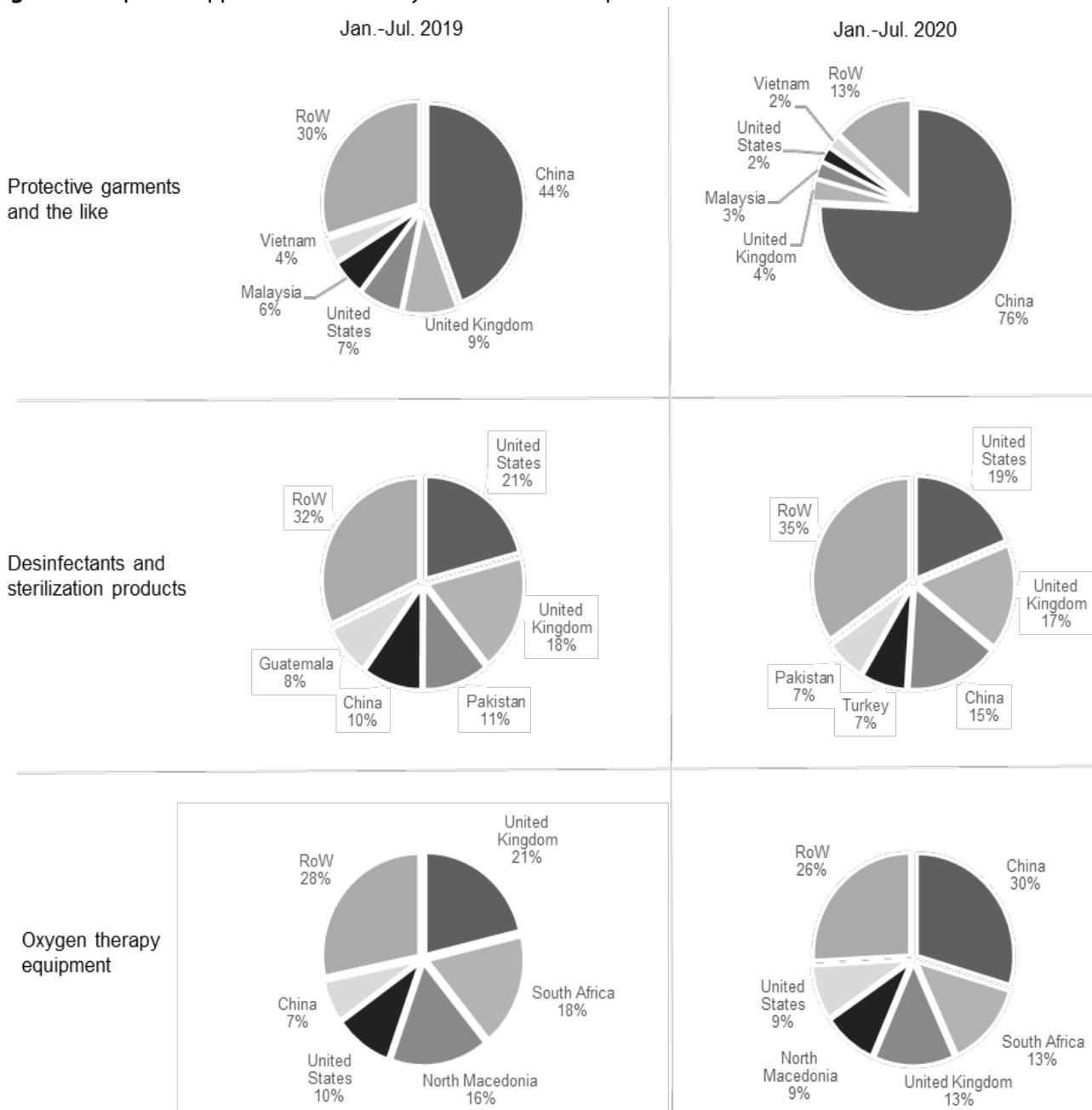
Source: Eurostat, 2020a

Note: Data refers to the period January to July 2019 and 2020, respectively (excl. intra-EU trade).

Figure 19 highlights that many of the additional imports of protective garments, disinfectants and sterilisation products, and oxygen therapy equipment in the first half of 2020 were being sourced from China, although this is not surprising given that China was a key supplier of the EU even prior to the 2020

crisis. Indeed, dependence on China for critical medical supplies is perhaps one of the most relevant economic insights of the pandemic. For instance, before COVID-19 approximately 60% of all protective garments and face masks were produced in China (Bown, 2020) and, as indicated, EU and US dependence on China only increased during the pandemic (Zeiger, 2020). According to Gereffi (2020), China will continue to play a crucial role in the GVC of medical products simply because of its increasingly large market. Yet, it would be misleading to interpret the dependencies as one-sided. Actually, the interdependencies between countries in trading PPE and medical devices are quite pronounced. Countries tend to be both importers and exporters of PPE and medical devices. Germany, for example, imports EUR 0.72 for every euro of exports of COVID-19 related goods (OECD, 2020b).

**Figure 19:** Top 5 EU suppliers of selected key COVID-19 medical products



Source: Eurostat, 2020a

## Potential for reshoring and alternative options

During the COVID-19 pandemic, a variety of measures were implemented, aiming at increasing the supply of different medical products in the EU. These included (i) export bans; (ii) intensified efforts to procure critical products, including changes to public procurement strategies (for example, joint procurement, and diplomatic efforts to prevent export bans of products and inputs); (iii) subsidies for new production lines (for example, new production lines of meltblown for facemasks in Germany); (iv) regulatory adjustments (for example, to speed up certification processes for new products such as new or more simplified ventilators); (v) quality control; and (vi) stockpiling. The European Commission (EC), for instance, provided guidance on regulatory issues, joint procurement of medical products as well as 100 % financing of stockpiles of FFP2 and FFP3 masks (rescEU medical reserve).<sup>26</sup> The measures varied for different products but were probably most visible for respirators because of the severity of the shortage. Despite all these efforts, the challenges of COVID-19 highlighted that reshoring critical medical products may be necessary in order to ensure sufficient supply during a crisis. This is because during a global crisis such as a pandemic, national strategies to secure sufficient supply of critical products prevail. For this reason, in addition to stockpiling and regulatory measures to increase the resilience of supply chains, creating a certain degree of local or regional production of various critical products may be deemed necessary.

The potential — and indeed the need — to reshore or increase local/regional production varies, given the large differences between diverse medical products and their respective GVCs. In general, the question of local production capacities is particularly pressing in the case of critical medical products necessary to fight pandemics like COVID-19, such as gloves, facemasks or respirators, for which the EU has a limited production capacity and high import dependency. In regard to facemasks, for example, efforts to increase local production capacities in the EU and many other countries had already taken off during the early phase of the pandemic, led largely by the textile industry<sup>27</sup>, and as a result, the global production potential of facemasks has increased significantly. This raises the question of economic sustainability once the pandemic is over. Indeed, Dan Reese, president of Prestige Ameritech, the largest domestic maker of medical N95 respirators, recalls the H1N1 flu outbreak in 2009/10, when his company increased capacity but ended up on the verge of bankruptcy after the crisis had subsided.<sup>28</sup> In the long term, production capacity in the EU may, thus, likely be sustained only through industrial policy support or adjusted purchasing strategies of (public) buyers (i.e., buyers that focus on supply security or sustainability standards and not only on prices).

Examination glove production is rather unlikely to be reshored, despite the cluster risk due to the concentration of global production in one single country, namely Malaysia. Much higher labour and energy costs, a lack of raw materials such as latex, tighter environmental regulation and very high upfront costs are all factors that inhibit investment in new glove production sites in Europe. For these reasons, examination glove production in the EU is likely to emerge only in the context of strong industrial policy

<sup>26</sup> See [https://ec.europa.eu/commission/presscorner/detail/en/IP\\_20\\_1709](https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1709) (04.11.2020)

<sup>27</sup> A non-exclusive list of investment projects in large European economies is as follows: Honeywell invested in a new production line in Scotland; Medicom and Dräger set up new production facilities in France; Mondi, Dräger and other firms launched new production lines in Germany. Innovatec and Sandler have both invested in new production lines for meltblown (meltblown fibres were the main bottleneck during the COVID-19 pandemic for quality facemasks) and in August 2020 Sandler inaugurated a new production line for nonwovens for facemasks, illustrating the time-lag in setting-up a new meltblown production line. This development does not reflect reshoring in a narrow sense but instead the investment in additional production capacities in the EU and the US without reducing production in countries such as China.

<sup>28</sup> See <https://apnews.com/article/health-global-trade-virus-outbreak-pandemics-fresno-02a0542e8a05176bd5d79757134bc277> (04.11.2020)

support. However, there has been no public discussion about the option of glove production in the EU, nor have policymakers provided any incentive to support such plans so far.<sup>29</sup>

In regard to more complex critical medical devices that are embedded in the producer-driven GVC, relatively large production capacities already exist in the EU, but they, too, depend on global supply chains. For example, the leading ventilator producers are concentrated in Europe, but their suppliers are scattered all over the world. In times of crises, local production is an advantage from an EU perspective, as know-how and productive capabilities are available within the borders of the EU. During the COVID-19 pandemic, the surge capacity of ventilator production was provided by (i) existing ventilator firms increasing their production;<sup>30</sup> (ii) cooperation between ventilator firms, firms from other sectors, and the military; and (iii) technical universities and industry newcomers with engineering backgrounds.<sup>31</sup>

Yet the surge capacity of ventilator producers was limited because of low automation potential and the difficulty in hiring appropriately skilled workers at short notice. Both the strict regulatory framework and the complex nature of ventilator technology create barriers to entry for new, inexperienced producers (Azmeah, 2020). However, the main vulnerability seemed to be due to single-sourcing (i.e., supplying specific inputs from only one supplier), which stems from high specialisation and relatively low output volumes. During the COVID-19 pandemic, one of the major reasons for delays in the production of ventilators was the temporary closure of a major Asian chip producer. This single company supplied specialised components to the majority of ventilator manufacturers worldwide. Given this GVC structure, incentivising ventilator firms to diversify away from single suppliers, and stress testing the entire GVC, are perhaps more reliable strategies than embarking on wide-scale reshoring of the entire supply chain.

Given the high costs and challenges involved in reshoring all — or even only specific — medical products, EU policymakers may wish to implement regulations that strengthen supply chain resilience and expand stockpiling efforts through various models (see pharmaceutical case study). For most medical products, shelf life is long and spans several years. In addition, the surge capacity of an economy also depends on a diverse manufacturing sector, capable of producing different elements according to complex specifications, and its cooperation with technical and medical universities. Digital technologies (3D printing) in combination with mechanical engineering form a powerful combination to shore up production in a wide array of product categories. This is important as the next crisis may require quite different solutions than those demanded by COVID-19.

## 4.5 Case Study 3: Semiconductors

Semiconductors, sometimes referred to as chips, microchips or integrated circuits (IC), form the backbone of every modern electronic device, enabling multiple simple and complex operations such as computations or data transfer (Dornbusch, 2018). They are typically made from pure elements such as silicon or germanium in a highly complex and capital-intensive production process.

A General-Purpose Technology (GPT) (Bresnahan and Trajtenberg, 1995), semiconductors are used in a variety of downstream industries and end-products, including smartphones, computers, TVs, and cars as well as advanced medical equipment. Semiconductors also demonstrate potential for large technological

<sup>29</sup> There is some discussion about a new production line in the US, but so far, no major investment has been announced. See <https://www.rubbernews.com/article/20110819/NEWS/308199993/howe-glove-manufacturing-reappearing-in-u-s> (04.11.2020)

<sup>30</sup> For example, the Swedish company Getinge has increased its production capacity by 160 % since 2019, see <https://news.getinge.com/us/getinge-to-further-increase-production-capacity-of-ventilators-in-2020> (04.11.2020)

<sup>31</sup> Compared to the machines produced by the ventilator companies, the new models have fewer functions and the technical setup is simplified. They are best thought of as low-cost emergency ventilators, i.e., they are designed for periods such as the COVID-19 pandemic.

improvements and offer innovative complementarities with R&D in sectors working with semiconductors further down the value chain. Semiconductors are considered enablers for the entire electronics value chain, which accounts for around 10% of global GDP (Millard et al., 2012; ESIA, 2020b). Indeed, on account of their immense potential productivity and growth effects, semiconductors have been identified (under the header of micro and nanotechnology) as a Key Enabling Technology<sup>32</sup> (KET) by the EC. These broad technologies are seen as crucial for maintaining Europe's systemic competitiveness and for solving societal challenges such as health, clean and efficient energy, climate action, among others.<sup>33</sup>

### **The semiconductor GVC and the EU's competitive position**

The semiconductor GVC can be broadly characterised as producer-driven (Gereffi, 1995b, 1999), dominated by large, not necessarily vertically integrated TNCs, mostly located in Asia and the US. The semiconductor industry is further characterised by a number of particularities as compared to other industries (PwC, 2013). Firstly, capital expenditure in the semiconductor industry is consistently among the highest, with around USD 100 billion capital spending per year in the last four years (IC Insights, 2019). A second particularity of the semiconductor industry is its high R&D intensity (PwC, 2013). US semiconductor firms spend around 16.4% of sales in R&D, recording the second-highest R&D intensity after Pharmaceuticals & Biotechnology, according to the EU industrial R&D investment scoreboard (Hernandez et al., 2020). Europe follows with around 15.3% R&D expenditure as a percentage of sales, in second place in a country/region comparison (ibid.). This high investment in innovation is not surprising, given the properties of this technology and past productivity increases. Thirdly, the industry is known for its highly cyclical demand. The development and manufacture of semiconductors are subject to very long lead times and producers are highly dependent on the demand for end-products, although this can vary to a great extent. Fourthly, in regard to production, the semiconductor industry is a truly global phenomenon. Certain activities in the production of semiconductors are often outsourced (sometimes globally) to specialised companies that focus only on specific stages of the manufacturing process. Indeed, a semiconductor device could cross 70 country borders before being finalised and used in an end-product (Accenture, 2019).

The manufacturing process of semiconductors can be roughly structured in four key steps (Millard et al., 2012; Dornbusch, 2018): (i) prior to production, a design needs to be developed. In a complex and very knowledge-intensive design process, a detailed plan is created that is elementary for the fabrication process further down the line; (ii) in the raw wafers production, thin slices (wafers) of very pure (> 99.9999%) semiconductor material (e.g., silicon) are produced in semiconductor fabrication plants (*fabs*); (iii) in the production step referred to as front-end manufacturing, wafers are processed further according to the design instructions. Typically, transistors are formed directly in the silicon to produce small, functioning pieces called *dies*; (iv) finally, *dies* are packaged into finished ICs (chips) and other semiconductor products in back-end operations.

The institution, *World Semiconductor Trade Statistics* (WSTS, 2017), distinguishes between four broad semiconductor categories: 1) *Discretes*, which have one basic function that cannot be divided into other functions, and include transistors or diodes that are not included in an IC; 2) *Optoelectronics*, which include displays, lamps, couplers and other opto-sensing and emitting semiconductor devices (e.g., LCDs); 3) *Sensors and Actuators*, whose electrical properties correlate to temperature, pressure, velocity, etc.; 4) *ICs*, which represent the vast majority of semiconductor devices in terms of sales with around 80% global

<sup>32</sup> Other KETs include advanced manufacturing, advanced materials, life-science technologies, artificial intelligence and security and connectivity.

<sup>33</sup> These and other societal challenges are named in the Horizon 2020 funding programme, the biggest EU Research and Innovation programme with around EUR 80 billion in funding over 7 years (2014 to 2020). See <https://ec.europa.eu/programmes/horizon2020/en/h2020-section/societal-challenges> (10.11.2020)

market share in 2019 (SIA, 2020; WSTS, 2020b). ICs were the fourth most traded product in 2018, representing 3.37 % of total world trade.<sup>34</sup>

The semiconductor industry has grown at a spectacular pace since its inception in the decades following the Second World War. A virtuous cycle of downscaling of transistor sizes and upscaling of performance induced exponential growth within the semiconductor market (Arden et al., 2010). In recent years, the industry has adopted a strategy referred to as 'More than Moore'<sup>35</sup>, where chip design and research evolve primarily in response to end-product demand, rather than being driven by the general goal of making semiconductors smaller and faster. The industry is, furthermore, characterised by a diversification of product types (multiple different semiconductor types integrated into a product) to fit the needs of ever more complex applications such as modern smartphones, cloud computing and the Internet of Things (IoT) (Waldrop, 2016; Decision, 2020). Nowadays, the global semiconductor industry is still a key growth sector of the global economy with projected worldwide sales of USD 426 billion in 2020 (from ~ USD 200 billion in 2000) that are expected to rebound to USD 452 billion in 2021 when the negative effect of COVID-19 is overcome (WSTS, 2020b).

Business models in the semiconductor industry can be broadly divided into (a) Integrated Device Manufacturers (IDMs), firms that integrate the whole value chain into their business model; (b) *Fabless* companies that do not produce their own chips but focus on design, IP licensing and outsource the production to external fabs or foundries; and (c) *Pure-play* firms, which constitute the flip-side of Fabless firms and typically produce semiconductors on demand. The US is the market leader in IDMs and Fabless with US-headquartered companies having a market share of sales of 51 % and 65 %. Notable market leader firms include Intel, Micron (IDMs) and Nvidia and Qualcomm (Fabless) (see also Table 2). South Korean IDMs (e.g., Samsung, SK Hynix) follow in second place with a 29 % market share (IC Insights, 2019). Europe has a stake in the IDM market, but only with a modest 9 % global market share (ibid.).<sup>36</sup>

The key lead firms are presented in Table 2. The production of semiconductors has been increasingly offshored to (East) Asia for decades (Millard et al., 2012). Asia had about 70 % of global manufacturing wafer capacity in 2017, with North America and Europe trailing behind at 13 % and 6 %, respectively (Decision, 2020). In addition to the lower costs of production in East Asian countries, the increasing production of, and demand for, consumer goods in this region also expedited the offshoring of semiconductor production to this region (ibid.). With increasing demand, it is not only production that has shifted to East Asia, but also global semiconductor sales in general. In recent years, the majority of revenue has been generated in China (> 30 % market share since 2016), followed by other Asia-Pacific (excluding China and Japan, with > 20 %) (SIA, 2020; Statista, 2020b). The Americas, Europe and Japan record market shares of around 20 %, 10 % and 9 %, respectively.<sup>37</sup>

The picture changes slightly when shifting the focus from sales to R&D, specifically to patents, a widely used indicator of the output of innovation activities.<sup>38</sup> Japan is by far the industry leader in terms of patents

<sup>34</sup> This is according to Harmonized system 4-digit classification (8542) and based on COMTRADE data harmonised by BACI, see [http://www.cepii.fr/CEPII/en/bdd\\_modele/presentation.asp?id=37](http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=37). The Observatory of Economic Complexity (Hidalgo and Simoes, 2011) is a valuable source for information where this trade data is analysed and visualised professionally, see <https://oec.world/en/profile/hs92/integrated-circuits> (04.11.2020)

<sup>35</sup> In 1965, Gordon Moore, co-founder of Fairchild Semiconductor and Intel predicted that, because of successful innovation in the sector, the number of transistors in a dense IC would double every year, which he later revised to every two years. This is known as 'Moore's Law' and largely held true, also because it was taken up by the industry and used as a roadmap to guide R&D efforts (Arden et al., 2010).

<sup>36</sup> This refers to EU-28 plus continental Europe but there is no significant semiconductor production in Europe outside the EU-28 Member States.

<sup>37</sup> Note: data of 2019 is the most current data available.

<sup>38</sup> Patents are extensively used to proxy the generation of new technological knowledge (see e.g., Pakes and Griliches, 1984; Schmoch, 1999).

generated in micro- and nanoelectronics, albeit with a declining share in the last decade from over 40 % in 2010 to around 34 % in 2017.<sup>39</sup> While, in recent years, most other regions have tended to maintain their global market share or experience modest losses, China has caught up rapidly, registering approximately the same number of semiconductor-related patents as the US in 2017 (19 %). The EU-27 region registered 15 % of all micro- and nanoelectronic-related patents in 2017, slightly below the 18 % it registered in 2010.

Asian countries not only possess the majority of production capacity, and generate the most revenue, but they also dominate international trade. The trade in ICs is mainly concentrated in East Asia, with China, Hong Kong, South Korea, Malaysia, Singapore, Vietnam and other Asian countries (including Taiwan) accounting for about 70 % of global trade volume in 2019 (see Figure 20). The EU, in particular Germany, and the US are the only countries outside of Asia with a significant trade share. Discrete semiconductors, which are increasingly used in modern systems applications ('More than Moore'), are less geographically concentrated as compared to ICs. This accounts for the relatively large portion of trade that is attributable to countries with a global share of below 1 % (indicated as RoW, Rest of the World in Figure 20). Moreover, the EU (especially Germany) is more active in the international trade of *discretes* than that of microchips. Germany and the Netherlands collectively enjoy a global trade share of 8 % in *discretes*, compared to less than 3 % in the case of ICs.

**Table 2:** Semiconductor sales — top companies

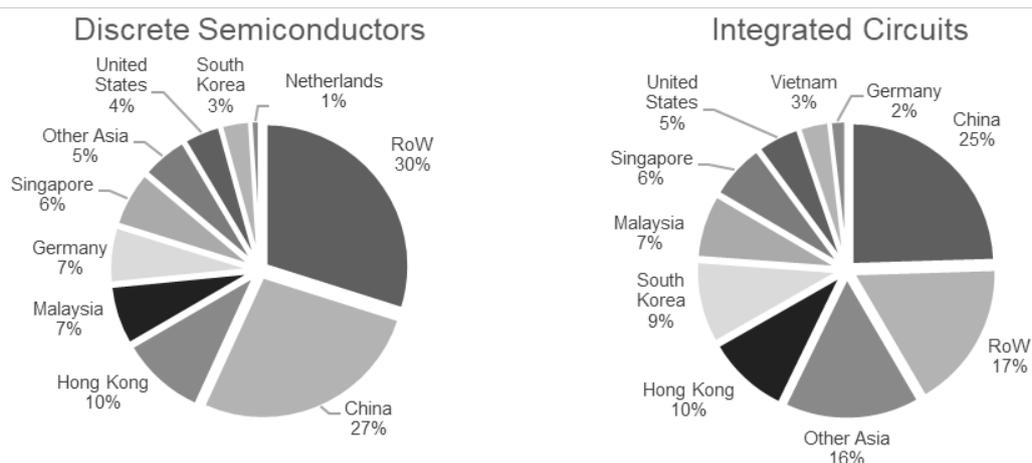
Company	sales 1H 2019	sales 1H 2020	R&D exp. 2017	R&D/sales (%) 2017
Intel (US)	32.04	38.95	13.10	21.2
Samsung (South Korea)	26.67	29.75	3.42	5.2
TSMC (Taiwan)*	14.85	20.72	2.66	8.3
SK Hynix (South Korea)	11.56	13.10	1.73	6.5
Micron (US)	10.18	10.62	1.80	7.5
Broadcom (US)**	8.35	8.11	3.42	19.2
Qualcomm (US)**	7.29	7.86	3.45	20.2
Nvidia (US)**	4.67	6.53	1.80	19.1
Texas Instruments (US)	6.88	6.24	n.a.	n.a.
HiSilicon (China)**, owned by Huawei	3.50	5.22	n.a.	n.a.

Source: IC Insights, 2019

Note: Leading semiconductor companies (including foundries) in first half 2019 and first half 2020, by sales revenue, R&D expenditure, (in billion USD), \*Foundry, \*\*Fabless

<sup>39</sup> Source: European Commission Data Dashboard (<https://ati.ec.europa.eu/data-dashboard/overview>). Shares based on global patent applications to the European Patent Office (EPO). Patents are localised according to patent applicant. Patents are categorised according to a list of International Patent Classifications codes (IPC) that are associated with micro- and nanoelectronics, see EC 2020c.

**Figure 20:** Global trade shares of integrated circuits and discrete semiconductors by volume, 2019



Source: UN Comtrade, 2020 (WITS)

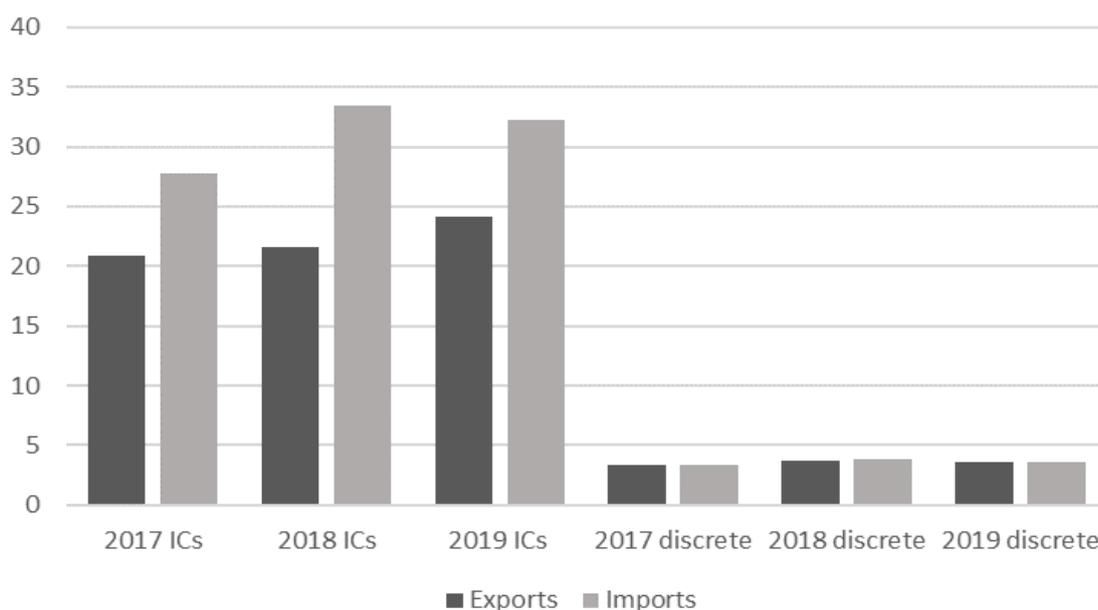
Note: Data include intra-EU-trade. For integrated circuits HS 2017 code 8542 was used. Discrete semiconductors are calculated as HS 2017 code 8541 less 6-digit codes associated with solar cell/panels (854140, 854150).

The European (EU-28 plus continental Europe) chip industry generated around USD 30 billion in sales per year over the last decade, directly supporting roughly 200 000 jobs and, indirectly, up to 1 million through its applications and services (ESIA, 2020b). European semiconductor companies have a market leader position in terms of sales in *discretes* (42 %), with Japan and the US following behind (at 25 % and 23 %, respectively).<sup>40</sup> European firms are also specialised in sales of Analog ICs (a subcategory of ICs) and hold a global market share of 22 % in this category. Europe is only surpassed by US-headquartered companies with a share of two-thirds of the market (SIA, 2020). Generally, European companies have embraced the ‘More than Moore’ trend and are well-positioned in these technologies (Decision, 2020). ‘More than Moore’ products are categorised by a diverse mix of (semiconductor) devices where the design and the integration in embedded systems (for professional end-users e.g., in automotive, industrial, and healthcare sectors) is often more important than a state-of-the-art fabrication plant. Europe is well equipped with wafer fabs from previous generations of semiconductor production that can still be used to produce ‘More than Moore’ products (ibid.). Roughly 37 % of semiconductors produced in the EU are supplied to the automotive industry, with a further 25 % produced for other industrial applications. Consequently, specialised EU firms are also global leaders in automotive semiconductors with a global market share of 29 % in 2019 (ESIA, 2020b). Companies including German Bosch, American-Dutch NXP Semiconductors, Swiss-headquartered STMicroelectronics and German Infineon are also expected to benefit from increasing digitalisation across the automotive sector (Deloitte, 2019).<sup>41</sup>

<sup>40</sup> Infineon Technologies, headquartered near Munich, Germany, but located throughout Germany, Europe and the World is the leading firm in the production of discrete semiconductors (Infineon, 2020).

<sup>41</sup> See also <https://www.handelsblatt.com/english/companies/semiconductors-european-chip-industry-aims-to-get-back-on-the-map/23582014.html?ticket=ST-7695617-meLvKAKefXdE0qvFX3b5-ap3> (10.11.2020)

**Figure 21:** Comparison of EU exports and imports of semiconductor products from 2017 to 2019, in billion USD



Source: UN Comtrade, 2020 (WITS)

Note: Data exclude intra-EU-trade. For integrated circuits HS 2017 code 8542 was used. Discrete semiconductors are calculated as HS 2017 code 8541 less 6-digit codes associated with solar cell/panels (854140, 854150).

The relative strength of European semiconductor firms in discrete semiconductors is not only reflected in sales, but it can also be seen in the trade balance (see Figure 21). While overall international trade is markedly smaller in *discretes* compared to ICs, the EU records an even trade balance with trading partners in this product type. Trade volumes in chips are higher by a significant margin, but the EU shows a negative net balance. There seems to have been no major shift in the net balance in either ICs or discrete semiconductors lately.

### Potential for reshoring

The Public-Private Partnership for Electric Components and Systems for European Leadership (ECSEL) project aims at boosting the competitiveness of the European electronics industry with its funding of around EUR 5 billion budgeted from 2014 to 2024.<sup>42</sup> While ECSEL is welcomed by the industry and several important projects have been realised as a result of the partnership, many industry commentators argue that EU support for the semiconductor industry has been too weak, for too long.<sup>43</sup> In recent decades, semiconductor industries in the US and Asia have enjoyed strong support through a variety of policy measures, which has resulted in the EU being overtaken in semiconductor production by countries such as

<sup>42</sup> EUR 80 billion are assigned overall to the Horizon 2020 project, of which around EUR 1.9 billion have already been allotted to the semiconductor industry. Of the remaining EUR 3.1 billion, EUR 2.1 billion were already funded by Member States or given in the form of in-kind contributions from the industry itself. Around EUR 1 billion is still outstanding until 2024. See <https://www.ecsel.eu> and <https://sciencebusiness.net/news/europes-semiconductor-companies-look-greater-support-horizon-europe> (10.11.2020)

<sup>43</sup> Examples include a new manufacturing process developed to reduce power consumption of smartphones by 40 % and one of the few new high-tech semiconductor factories in Europe, built by Bosch in Dresden that is expected to open late 2021; see <https://sciencebusiness.net/news/europes-semiconductor-companies-look-greater-support-horizon-europe>, <https://www.handelsblatt.com/english/companies/semiconductors-europe-an-chip-industry-aims-to-get-back-on-the-map/23582014.html?ticket=ST-789670-ICaodiiL6xkWBRhrD9Ts-ap6> (10.11.2020)

Singapore, Taiwan, South Korea, China and the US. Within the new comprehensive research and innovation programme Horizon Europe, the successor of Horizon 2020, the EU is planning to further support the European semiconductor industry. Of the EUR 100 billion total funding of Horizon Europe, around EUR 10 billion are projected for the successor project to ECSEL, the Key Digital Technologies Joint Undertaking (KDT JU).<sup>44</sup> The goals of the project are to boost the EU's competitiveness in the electronics supply sector (including semiconductors), to support the digital transformation of all sectors of the economy and society and to contribute to achieving the objectives of the European Green Deal. Whether these ambitions will be realised, of course, remains to be seen.

The semiconductor industry also follows, to a certain degree, the trend towards regionalising GVCs. China, for example, is investing massively in its domestic chip industry and is on track to become a largely self-sufficient leader in advanced technology by 2025.<sup>45</sup> The trend towards regionalisation of trade may be attributed to some extent to reshoring activities, with high-tech companies demonstrating a greater tendency to reshore as compared to those in other industries (Heikkilä, Martinsuo and Nenonen, 2018b; Dachs et al., 2019; Dachs, Kinkel and Jäger, 2019). In the semiconductor industry, this trend is being driven largely by new technological developments, specifically digital manufacturing technologies (Industry 4.0) and the IoT (Dachs, Kinkel and Jäger, 2019). Industry 4.0 might influence backshoring processes in two major ways. First, factor cost advantages of offshoring locations could be neutralised through positive productivity effects induced by Industry 4.0 (ibid.). Second, the promise of more flexible manufacturing processes might provide incentives to move more production closer to key buyers, for example, the automotive industry in the EU (Ancarani, Di Mauro and Mascali, 2019), although as already discussed above, these effects need not hold for all (high-tech) industries. While, of course, the effects of Industry 4.0 applications on location decisions might also go both ways, thus not necessarily benefitting Europe vis-à-vis Asia and the US, we do believe that semiconductor production in Europe likely stands to benefit from technological developments related to Industry 4.0.

If technological developments can further erode the production cost advantage of Asian countries with established chip production, the increased flexibility in manufacturing and shorter lead times expected from new production processes should favour (re-)location of semiconductor production capacity to the EU. What is more, policies to strengthen European regional value chains in the semiconductor industry could show substantial synergies with missions outlined in the Horizon Europe program.<sup>46</sup> For example, the mission to achieve climate-neutral smart cities would benefit as new tailor-made products and applications could be developed and produced faster and more sustainably with a strong local semiconductor industry. Importantly, considering possible supply chain disruptions caused by geopolitical rivalries (as exemplified by US trade restrictions on China) in the future, it would be in the EU's interest to maintain — or further develop — state-of-the-art semiconductor manufacturing capacity within the union.

The EU is strong in 'More than Moore' technologies, and European semiconductor companies in this field work well with downstream enterprises that implement these technologies in their products, such as those in the automotive and industrial sectors. Investment in these new approaches seems warranted as 'More than Moore' semiconductor technologies have been identified as future growth markets (Deloitte, 2019). It is vital that some part of (high-value, 'More than Moore') chip manufacturing is brought back, or newly established, in Europe. This is even more true given the industry's dependence on continued R&D and the increasing importance for high-tech products of having close proximity between R&D and production facilities. Currently, European semiconductor companies are highly innovative and in a favourable position

<sup>44</sup> See [https://ec.europa.eu/info/sites/info/files/research\\_and\\_innovation/funding/documents/ec\\_rtd\\_he-partnerships-for-key-digital-technologies.pdf](https://ec.europa.eu/info/sites/info/files/research_and_innovation/funding/documents/ec_rtd_he-partnerships-for-key-digital-technologies.pdf) and <https://blog.semi.org/semi-news-europe/semi-responds-to-eu-white-paper-on-artificial-intelligence> (10.11.2020)

<sup>45</sup> Beijing has allotted more than USD 150 billion in support for the semiconductor industry, see e.g., <https://thediplomat.com/2020/09/can-china-become-the-world-leader-in-semiconductors/> (21.12.2020)

<sup>46</sup> See [https://ec.europa.eu/info/horizon-europe/missions-horizon-europe\\_en](https://ec.europa.eu/info/horizon-europe/missions-horizon-europe_en) (10.11.2020)

in terms of R&D; however, there is the danger that these R&D centres move closer to production sites in the future (Dornbusch, 2018). To impede this potential exodus of R&D activity away from Europe, significant production capacity needs to be maintained and strengthened within the EU.

The biggest barrier to reshoring is the extremely high capital intensity of the global semiconductor industry. A modern chip factory can cost as much as EUR 10 billion, so any investment must be targeted well.<sup>47</sup> Another obstacle to widespread reshoring is the need for a highly skilled and specialised workforce in *fabs*, the absence of which could lead to bottleneck situations (Kinkel, Pegoraro and Coates, 2020). While increasing digitalisation and new trends in production processes and organisation (e.g., Industry 4.0) make reshoring of the semiconductor industry increasingly likely, the highly globalised organisation of the industry and the immense costs associated with moving or newly establishing semiconductor production capacity will likely deter companies from any significant reshoring efforts.

The COVID-19 crisis had unprecedented effects on the global economy and the semiconductor industry, but the semiconductor GVC proved to be relatively resilient during this time of crisis.<sup>48</sup> Major (semiconductor) industrial hubs recorded a sharp drop in industrial production as national governments introduced lockdowns in spring 2020 (WEF, 2020). The European Semiconductor Industry Association records a year-to-date decline of 8.7 % in European semiconductor sales in October 2020, as compared to 2019 (ESIA, 2020a). However, the global semiconductor market is expected to grow about 5 % in 2020, owing to the relative success of several Asian countries in battling the economic effects of the pandemic (WSTS, 2020a). In general, COVID-19-induced reshoring in the semiconductor industry is unlikely, and major policy interventions will be required if there is any hope of significantly increasing semiconductor production capacity in the EU (Beattie, 2020).

## 4.6 Case Study 4: Solar energy

EU energy policy places a high priority on renewable energy because of the important contribution that this form of energy can make towards security and diversification of energy supply, climate change mitigation and social and economic cohesion. A major objective of the European Green Deal is that Europe becomes the first climate-neutral continent by 2050. This can only be achieved by embracing renewable energy sources. Indeed, the share of the EU's renewable energy consumption almost doubled from 9.6 % in 2004 to 18.9 % in 2018 (Eurostat, 2020b). While wind energy was the single largest source of renewable electricity generation in the EU in 2018, electricity from solar recorded impressive growth from 7.4 terawatt-hours (TWh) in 2008 to 115 TWh in 2018 (*ibid.*). The photovoltaic energy sector is expected to continue growing rapidly in the coming decades (Fraunhofer ISE, 2020). Besides a growth in capacity, the solar energy sector has seen major technological progress that has contributed to price reductions, making it cheaper than competitor technologies, whether renewable or non-renewable (SolarPower Europe, 2020b). Generous governmental support for this clean form of energy generation in various forms has also helped cut costs. What is more, the solar photovoltaic industry employs more people than any other renewable energy technology, currently providing about one-third of all jobs across the renewable energy sector (IRENA, 2020).

### **The solar energy GVC and the EU's competitive position**

The solar energy industry can be broadly divided into solar photovoltaic (PV, solar cells/modules), solar thermal heating and cooling applications and concentrated solar power (CSP), a technology where mirrors are used to concentrate the sun's energy to power traditional steam turbines or engines that create electricity. Of these three categories, the solar photovoltaic segment is the most important, with by far the

<sup>47</sup> See e.g., <https://www.handelsblatt.com/english/companies/semiconductors-europe-an-chip-industry-aims-to-get-back-on-the-map/23582014.html?ticket=ST-7695617-meLvKAKefXdE0qvFX3b5-ap3> (10.11.2020)

<sup>48</sup> Samsung, for example, located in South Korea, did not report any meaningful production delay.

highest share in total installed capacity, growth prospects and employment (IRENA, 2020). This report will, therefore, limit its focus to the solar photovoltaic sector.

Compared to other forms of energy, the PV sector is characterised by very high up-front investment, followed by relatively low maintenance and zero fuel costs (IEA-PVPS, 2019). While capital investments are very high, there is broad general public support for renewable energy and the solar industry has come to rely on a variety of governmental policies (see below) to support the rollout of PV technologies.

The upstream PV value chain for wafer-based crystalline PV cells consists of three key stages (IEA-PVPS, 2019):<sup>49</sup> (i) First, polysilicon production creates polycrystalline silicon (polysilicon, poly-Si) that serves as a basis for solar cells; (ii) Next, ingots and wafer are manufactured where ingots (single-crystalline, sc-Si or multi-crystalline, mc-Si) are produced from purified polysilicon; and (iii) In solar cell and module production, wafers are further processed to create finished solar cells that are the smallest power-producing unit in a PV system. Cells are then interconnected and encased between a transparent front (usually glass) and a backing material that is often plastic or glass, thus forming a single photovoltaic module, also known as a solar panel. The global solar cell energy production in 2018 amounted to about 116 gigawatts (GW).

The downstream PV chain can be categorised using the example of a utility-scale PV project (ibid.). The largest solar plants in terms of power production (> 1 000 kilowatts (kW), ground-mounted) are referred to as utility-scale. Supplier companies produce and supply PV modules as well as other components of a finished PV system. EPC / Installers / O & M companies provide engineering, procurement and constructions (EPC) and include specialists and general construction firms. There is a further need for Operating & Management (O & M) of PV systems, although maintenance requirements for solar power are relatively low. Independent power producers (IPPs) are located at the end of the downstream solar GVC. IPPs generally own utility-scale power plants (with equity investors) and sell the electricity produced to utility companies under long-term contracts. Integrated developer companies can cover multiple downstream sectors such as EPC and O & M. Some of the major manufacturers of PV modules are vertically integrated and, thus, also active in downstream activities (see below).

Solar modules can be ground-mounted in large utility-scale plants, fixed on tracking systems that follow the sun to maximise efficiency, put on industry or residential rooftops or even integrated into building materials such as roof shingles. Solar power plants can be connected to the electricity network (grid-connected) or work independently of it (off-grid) either powering residential consumers or supplying power to remote places that are not well-connected to the power grid. Grid-connected PV systems can be further divided into distributed and centralised systems. Distributed systems provide electricity either to a grid-connected consumer or directly to the power grid, usually at the location of demand (IEA-PVPS, 2019). While distributed PV systems are located close to the site of demand, thus enabling short distances between power supply and power consumption, they can be problematic for the power grid sometimes not built for the supply of solar energy at the location of load.<sup>50</sup> Centralised PV systems, on the other hand, are comparable to conventional power stations in that they are not associated with a particular consumer but located at a resource-heavy location and properly connected to the power grid. Globally, between 60 % and 70 % of newly installed grid-connected systems were centralised from 2014 to 2018 (ibid., latest data). However, this varies from between around 36 % in Europe to more than 90 % in the Middle East and Africa.

<sup>49</sup> This form of PV cell remains the dominant technology for production. Other, newer technologies include compound semiconductor (thin-film) and organic thin-film PV.

<sup>50</sup> See e.g., <https://woodsinsitute.stanford.edu/system/files/publications/Solar-UD-Distributed-vs-Centralized-Power-Generation-20100408.pdf> (25.11.2020)

Overall, the PV industry has seen phenomenal growth over the last two decades. Having arguably started to take off after the launch of Germany's feed-in-tariff (FiT) in 2000,<sup>51</sup> solar power capacity has since grown almost 400 fold, totalling 633.7 GW at the end of 2019 (SolarPower Europe, 2020b). Much of that growth has occurred over the last 10 years, with global capacity having increased to current levels from only 41.4 GW in 2010 (ibid.). When compared to other (renewable) energy sources, solar energy is on the rise and accounts for almost 50 % of capacity installed in 2019 (117 GW), followed by wind power (61 GW), gas (30 GW), coal (18 GW) and hydro (15 GW) (BNEF, 2020). Notwithstanding the impressive growth in recent years and expected upward future trajectory, renewable energy in general, and also solar in particular, still account for only a very small share in total electricity produced. Non-solar renewable energy production amounted to 23 % of global power generation in 2019 (22 % in 2015) and solar power increased its share from 1 % in 2015 to 2.6 % in 2019 (BNEF, 2020; IRENA, 2020).

The rapid rise of solar power is mainly driven by two key developments. First, technological progress has contributed to massive price reductions in solar energy, highlighting the importance of R&D in this industry (Fraunhofer ISE, 2020). Overall, electricity generation costs of solar have dropped from about 350 USD/MWh in 2009 to around 40 USD/MWh in 2019, making it more competitive than wind and even cheaper than conventional energy sources such as nuclear, gas and coal, in particular circumstances (Lazard, 2019). The second main reason for the uptake in solar power is the generous governmental support the industry has received globally. The three historically most important support mechanisms include FiT (including tenders), direct subsidies or tax breaks, and incentivised self-consumption (IEA-PVPS, 2019). FiTs are support schemes where official bodies pay a predefined price for a project's solar electricity injected into the grid, over a fixed period of time. In 2018, around 76 % of PV installations received some form of predefined tariff (ibid.). Because prices generally dropped faster than tariffs were adjusted, this proved very lucrative for PV developers. In calls for tenders, governmental bodies propose a maximum capacity for a project and take bids from competing developer companies for a minimum feed-in-tariff. This leads to very competitive prices for solar energy projects with some utility-scale, grid-connected centralised projects offering solar power below 2 USD cents/kWh (e.g., in Portugal, the United Arab Emirates and Brazil) (SolarPower Europe, 2020b). Around 15 % of historical projects received direct subsidies or tax breaks to incentivise investment and about 13 % have utilised incentivised self-consumption schemes, which support distributed consumers to reduce their electricity bill by supplementing with solar power (IEA-PVPS, 2019).

The global solar power industry recorded a turnover of around USD 132 billion in 2018, based on average prices of PV system installations (IEA-PVPS, 2019). Overall, the EU does not play a significant role in the upstream solar photovoltaic GVC. Instead, global production is highly concentrated in China, as can be seen in the breakdown of key global solar energy companies in Table 3. These companies dominate the whole PV GVC and are often vertically integrated as they also manufacture solar modules. Consequently, the upstream PV value chain is mainly located in Asia, in particular in China (accounting for 58 % of polysilicon production in 2018), South Korea (16%), although Germany and the US also account for 13 % and 7 %, respectively, of global production. Notable polysilicon manufacturers include GCL-Poly Energy (China), the single largest polysilicon producer (61 000 tons in 2018) and Wacker Chemie (Germany), which produced around 58 000 tons in 2018 (ibid.). Wafers are almost exclusively produced in China, accounting for 93 % of global output in 2018. Similarly, the global solar cell (c-Si and thin-film cells) production is also heavily concentrated in China (74 %), followed by Taiwan (7 %), Malaysia (6 %),<sup>52</sup> South Korea (5 %) and Japan (2 %). The EU, by comparison, does not currently have any meaningful solar cell production (0.1 %).

<sup>51</sup> See below for a general explanation of feed-in-tariffs. For an overview of Germany's FiT from 2000, see e.g., <https://www.cleanenergywire.org/factsheets/20-years-german-renewables-pioneers-face-end-guaranteed-payment> (22.12.2020)

<sup>52</sup> Many major international PV manufacturing companies from China, South Korea, the US, Japan, a.o., have factories in Malaysia.

China also dominates the manufacture of PV modules with a global share of 73 % in 2018, followed by South Korea (6 %), Malaysia (5 %), Europe (3 %) and India (2 %), with all other countries producing equal to or less than 1 % of modules. The overwhelming majority of modules are crystalline-silicon based (c-Si, 97 % in 2018), among which the share of sc-Si is increasing as compared to mc-Si, reflecting increasing demand for higher performance offered by sc-Si. Thin-film modules are an up-and-coming variant that promises greater efficiency, although its production is somewhat more complex, and it still represents a relatively low share of global module supply (3 % in 2018). This variant is currently mainly produced by the US company First Solar (ibid.).

Globally installed solar PV capacity is expected to continue to grow exponentially with up to 12 terawatts (TW) in capacity forecast by 2030 (Fraunhofer ISE, 2020). Prior to 2014, the majority of installed capacity was located within the EU, although over the last decade, the EU has been overtaken by other regions (see Figure 22). Today, the majority of installed solar capacity is located in the Asia-Pacific region, and in particular, China. Nonetheless, the EU continues to play a major role in the solar energy sector as a market for PV products. Germany is the major player, accounting for a 37 % share (45.9 GW) of the total installed capacity of 125.8 GW in 2018, followed by Italy, with around 20 GW (SolarPower Europe, 2019). Overall, the EU continues to be characterised by relatively high growth rates with regard to the installed solar power capacity, with 18 out of 28 countries increasing their new capacities between 2018 and 2019.

The recent growth in solar power in the EU has been largely promoted by the EU 2020 binding targets for renewable energy and associated governmental support. The EU seeks to source a 20 % share of its gross final energy consumption from renewables by 2020 (Eurostat, 2020b) and solar, in comparison to other renewables, is particularly attractive to consumers in the EU in that it is relatively flexible and often the lowest-cost renewable energy available (SolarPower Europe, 2019).

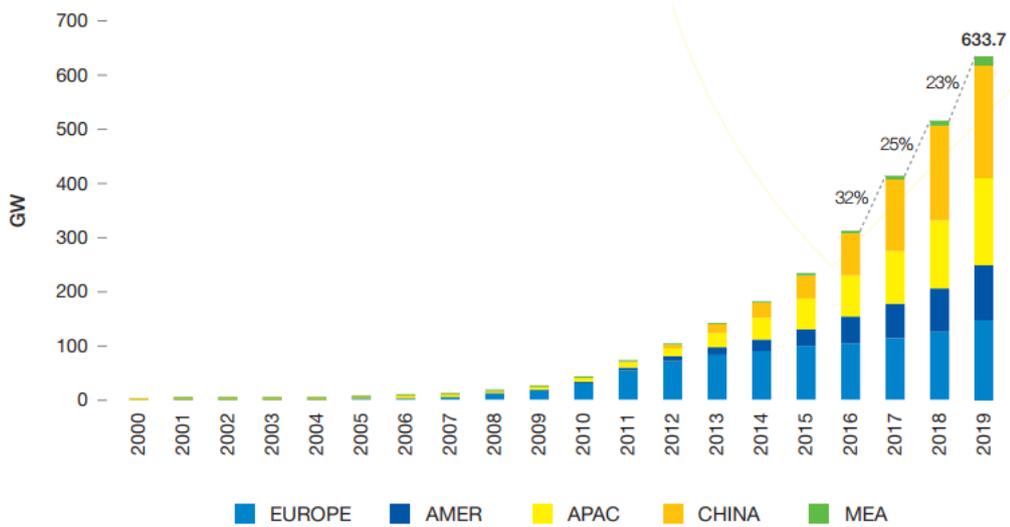
**Table 3:** Major solar energy companies, 2018

Company	integrated developer	Manufacturer	FY 2018
Canadian Solar (Canada/China)	x	x	3744.5
Jinko Solar (China)	x	x	3642.3
Trina Solar (China)*	x	x	3035.5
JA Solar (China)*	x	x	2821.0
LONGi Solar (China)*		x	2378.9
First Solar (US)	x	x	2244.0
Hanwha Q Cells (South Korea)*	x	x	2188.9
GCL System Integration (Hong Kong)	x	x	1627.0
Risen Energy (China)*	x	x	1560.0
Yingli (China)*		x	1285.5

Source: Statista, 2020a

Note: FY refers to a full year. \*Figures for 2017 were used. Figures for Trina Solar are for FY 2015. Revenue in million USD.

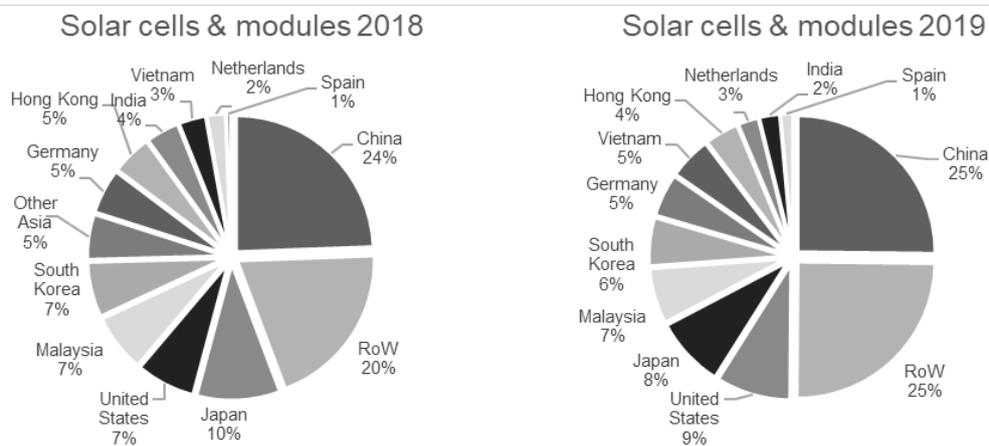
**Figure 22:** Annual solar PV cumulative installed capacity per region, 2000 to 2019



Source: SolarPower Europe, 2020b

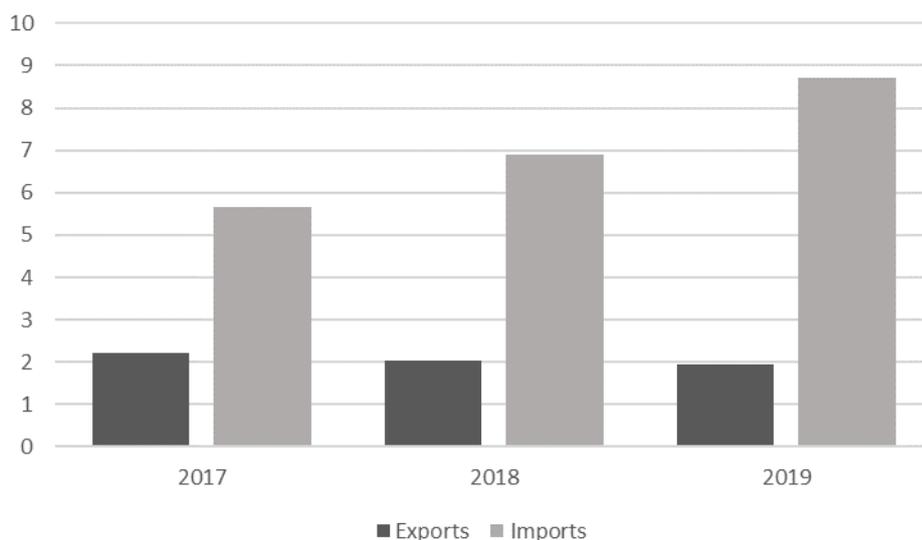
Note: AMER, APAC, MEA refer to Americas, Asia-Pacific and Middle-East and Africa. The last three growth rates of newly installed capacity are shown in the figure.

**Figure 23:** Global trade shares of solar cells and modules by volume, 2018 and 2019



Source: UN Comtrade, 2020 (WITS)

Note: Data include intra-EU-trade. The HS 2017 6-digit codes associated with solar cells/modules 854140 and 854150 were summed to approximate trade in solar cells/panels.

**Figure 24:** Comparison of EU exports and imports of solar cells and panels from 2017 to 2019, in billion USD

Source: UN Comtrade, 2020 (WITS)

Note: Data exclude intra-EU-trade. The HS 2017 6-digit codes associated with solar cells/panels 854140 and 854150 were added to approximate trade in solar cells/panels.

### Potential for reshoring

In order to achieve the goals of the European Green Deal, the EU needs to embrace renewable energy sources to an even greater extent than it has in recent years. Solar energy is the most promising form of renewable energy, both in terms of growth potential and possible employment effects, which can be expected in manufacturing as well as downstream elements of the PV GVC (IRENA, 2020). A strong domestic solar cell manufacturing sector in the EU would also be conducive to further decreasing energy dependence on other regions.

As indicated above, the important role of the EU in terms of installed solar power capacity stands in stark contrast to its lack of local manufacturing capacity. The production of mainstream (c-Si) solar panels for the EU market has moved almost exclusively to Asia as low production costs and sufficient scaling have become more important, and the possession of proprietary intellectual property increasingly less relevant (Carvalho, Dechezlepretre and Glachant, 2017). It seems unlikely that this type of solar cell production will be reshored or newly established in the EU by European solar companies. Compared to other high-tech electronics sectors (see, e.g., case study semiconductors), the solar industry is not as tightly connected with downstream industries, and therefore, proximity to buyers is not as important for manufacturing, thus dampening motivation for reshoring to the EU.

In regard to thin-film PV, while the global share is low (around 3%, see above), the technology is very promising. The production process of thin-film cells, which involves depositing thin layers of semiconductor materials onto a backing material (usually glass, stainless steel or plastic), potentially requires less capital and energy and is more efficient than that of crystalline-silicon modules (IEA-PVPS, 2019) making the technology much more compatible with the EU's focus on sustainable industry. However, there have been more failures than successes in attempts to bring the technology to market, with multiple bankruptcies in recent years. R&D centres in the US and Europe still hold technological leadership in thin-film solar cells, but more policy support and investment are needed to properly bring

this technology to fruition (Beck, 2020).<sup>53</sup> Industry experts believe that it is not too late for the EU (and the US) to keep their relatively strong international position in thin-film technologies, in particular vis-à-vis China, if proper investment and support is available (ibid.; Fraunhofer ISE, 2020).

The COVID-19 crisis had a negative impact on the European solar industry. In a survey by SolarPower Europe, the majority of companies that answered reported a significant decline in orders and client demand (SolarPower Europe, 2020b). Early in 2020, disruptions in the supply chain were reported, mainly because of closures in crucial Chinese component manufacturers (ibid.). However, the solar industry rebounded strongly after the first lockdowns were lifted. Germany, for example, recorded more installations in May and June 2020 as compared to the same period in 2019 (IEA, 2020). To support the economy and ensure economic recovery and the further promotion of investment in a more sustainable economy, the EU announced a COVID-19 relief programme entitled 'Next Generation EU', in May 2020.<sup>54</sup> The EUR 750 billion support program consists, to a large extent, of loans and grants, and to a lesser extent, of additional financial support for established EU policies (such as Horizon Europe and Just Transition Fund). It aims to rebuild a post-COVID Europe, making it greener, more digital and more resilient. The focus on green recovery means more financial support for renewable energy, a move welcomed by solar industry associations who stand to benefit from support for the domestic solar industry (Lempriere, 2020; SolarPower Europe, 2020a), although it remains uncertain whether this funding will initiate the re-establishment of major solar cell production capacity in the EU, or mainly boost the downstream PV sector in the form of additional installations and centralised solar projects that use predominantly imported solar panels.

## 4.7 Comparative conclusions

This section has provided empirical evidence illustrating an increasing trend towards reshoring over the last decade, with larger firms and medium to high-tech industries among those with the highest reshoring propensity. Reshoring processes have, however, been limited so far in scale and have, thus, not had a pronounced effect on the EU economy as a whole. These limited effects are partly related to the fact that reshoring has, so far, mainly occurred at an intra-EU level, even though reshoring from Asia and China is on the rise. Additionally, it should be noted that an increasing number of reshoring processes does not necessarily mean that offshoring strategies are no longer being pursued. Effects on employment are also low, in particular because of the role of automation in driving reshoring processes.

The drivers of reshoring are diverse and often related to lack of flexibility, quality issues and the importance of proximity to specific markets or end-users. However, the empirical literature has been largely focused on microeconomic motivations for reshoring, while other factors such as macroeconomic crises or changes in economic policy are often not considered. The empirical literature provides, for example, information on company and market-specific motivations for reshoring, but it is not indicative of reshoring decisions due to the current COVID-19 situation or macroeconomic and political development such as the changing geopolitical situation.

In regard to sectoral potentials for reshoring to the EU, our survey of the literature highlights a certain degree of agreement that technology-intensive industries are more likely to backshore to the EU, and that this is largely due to either economic or political reasons. From an economic perspective, automation processes, increasing flexibility, and reduced lead times have driven the machinery, electrical and transportation equipment, and potentially also the electronic sectors towards reshoring to the EU. Other

<sup>53</sup> See e.g., [https://www.eurekaalert.org/pub\\_releases/2020-02/hbfm-cts020520.php](https://www.eurekaalert.org/pub_releases/2020-02/hbfm-cts020520.php) (11.12.2020)

<sup>54</sup> See e.g., [https://ec.europa.eu/info/strategy/recovery-plan-europe\\_en#main-elements-of-the-agreement](https://ec.europa.eu/info/strategy/recovery-plan-europe_en#main-elements-of-the-agreement) (11.12.2020)

sectors such as those involved in medical products, chemicals, pharmaceuticals, aerospace, communication, automotive and electronics tend to reshore due to political reasons, for instance, to increase supply security and regional competitiveness, or on account of national security considerations.

This section has presented four sector case studies on medical products, pharmaceuticals, semiconductors and solar energy to assess sector-specific potentials in more detail. The reshoring discussion for medical products and pharmaceuticals is particularly motivated by concerns for the security of supply of critical products. Reshoring of semiconductors is mainly related to the EU's strategic autonomy as well as technological sovereignty. The reshoring discussion with respect to solar panels is currently limited, but the EU's plans for a green transition raise the question of whether domestic manufacturing capacities for solar panels are necessary. In all four case studies, reshoring is highly dependent on political decisions and industrial policy support, given that the economic reasons for reshoring are weak (Table 4).

The case studies have shown that supply shortages due to COVID-19 occurred mainly in certain medical products, such as PPE. These shortages were triggered by a combination of GVC interruptions due to lockdowns and temporary export restrictions, but most importantly, they followed a surge in demand for these products. With respect to reshoring, the case studies highlighted the importance of considering specific sector and GVC dynamics when assessing reshoring potential. An important finding relates to the large degree of heterogeneity within sectors. For example, reshoring in pharmaceuticals and medical products is particularly relevant with regard to intermediate products for generic pharmaceuticals (APIs) and PPE, respectively, and less so for on-patent pharmaceuticals or complex medical devices, given the existing production capacities for the latter in the EU. However, for most of these previously offshored products — many of which may be considered critical — reshoring is unlikely for a variety of reasons. These relate in particular to economic factors such as the economies of scale required for efficient production, the high sunk costs associated with established complex supplier networks, persistent labour cost advantages, as well as high sustainability standards in the EU (Table 4). Under these circumstances, reshoring will only occur for political reasons (strategic autonomy and security of supply considerations) and if substantial financial incentives are offered to companies. Given the large number of pharmaceutical and medical products deemed critical, a general policy approach based on subsidisation will be, arguably, unfeasible.

The competitiveness of the EU semiconductor industry has suffered, with the exception of certain niche segments, such as semiconductors produced for the automotive industry, which is why economic factors for reshoring are limited (Table 4). However, there is a case for considering semiconductors in particular, and microelectronics in general, as a strategically important industry, as exemplified by the EU's classification of microelectronics as an IPCEI. The manufacturing of semiconductors is geographically concentrated in South-East Asia and has recently become the target of strategic actions by the US to restrict access for Chinese companies to high-tech chips. A fragmentation of the semiconductor GVC in the near to medium-term future is likely, with the US and China seeking to restrict each other's access to key technologies, by incentivising reshoring of manufacturing capacities, among other things.<sup>55</sup> As a consequence, EU companies might be forced to look for alternative sourcing options. Under these circumstances, expanding manufacturing capacities in the EU might be one element of a more comprehensive geographical diversification strategy. Given the strategic importance of the sector, the EU might want to support this.

In the solar energy industry, the manufacturing of solar panels has been completely offshored/outsourced to East Asian producers, mainly from China, and again the economic case for reshoring appears weak (Table 4). Given the importance of solar energy for the energy transition required by the climate targets

<sup>55</sup> See <https://www.cnbc.com/2020/09/18/a-brewing-us-china-tech-cold-war-rattles-the-semiconductor-industry.html> (11.12.2020)

under the Paris agreement, installed solar capacity will have to be increased dramatically, both in the EU and other countries. Given ecological imperatives, and the large public investment push necessary for implementation, there is however a case for vertical integration of the EU solar industry, including through expanding domestic production capacities. The EU should, in particular, exploit the potential to regain some market share in the manufacturing of high-tech new products (thin-film cells). However, given large differences in production costs and the dynamic efficiencies of established production networks in East Asia, which have greatly profited from government support in the past, targeted policy-support will be needed to bring manufacturing back to the EU. Table 4 provides a summary assessment of the drivers of reshoring in the four case studies.

**Table 4:** Indicative overview of reshoring potentials to EU for case study sectors

Driver	Pharmaceuticals	Medical products	Semi-conductors	Solar energy
Economic factors I (current cost differentials, sunk investment costs)	--	--	-	--
Economic factors II (quality issues, transport costs, proximity of market, Made-in effects etc.)	o/+	o/+	+	o
Digitalization – ICTs	-	-	-	-
Digitalization – Automation/Industry 4.0	o/+	o/+	+	o
Digitalization – Additive Manufacturing	o/+	o/+	o	o
Security of supply considerations	++	++	o	o
Strategic autonomy/technological sovereignty	+	+	++	+
<b>Summary (economic-technological / political factors)</b>	<b>-/+</b>	<b>-/+</b>	<b>-/+</b>	<b>-/+</b>

Source: own elaboration based on expert assessments (literature review, expert interviews and discussions amongst the members of the research team).

Note: -- strong negative effect on reshoring decisions, - negative effect on reshoring decisions, o insignificant effect on reshoring decisions, + positive effect on reshoring decisions, ++ strong positive effect on reshoring decisions. The assessment only takes account of previously offshored industry segments.

## 5 Overview of the reshoring policies in selected major EU trade partners

This section reviews economic policies affecting reshoring in the US, the UK, and Japan. Although unfair foreign competition, reshoring and nearshoring play an important role in the policy discourse during elections (especially in the US), there are, with the exception of the recent COVID-19 recovery package in Japan, *no policies explicitly designed* for the purpose of bringing back previously offshored productive capacity that can be identified. Rather, reshoring and nearshoring are best understood as desired by-products of wider industrial strategies or trade policies that may encourage or discourage reshoring.

Reshoring can be encouraged through increasing production costs in countries that traditionally attracted offshoring firms, improved competitiveness in the home country, and greater flexibility (just-in-time (JIT), rapid response to changes in consumer demand) by moving production closer to markets (Piatanesi and Arauzo-Carod, 2019). Countries have a number of options to encourage reshoring or nearshoring:

- 1) Financial incentives: subsidies, tax incentives, loans, public equity participation, public procurement, land and infrastructure provision;
- 2) Innovation policies: investment support, for example, for technological upgrading to Industry 4.0 / additive manufacturing, research centres and academic programmes for workforce upgrading;
- 3) Industrial policies: identification of grand challenges, missions, sectors, industrial clusters, etc. to channel investment into strategic areas;
- 4) Trade policies: tariffs/quotas for imported inputs; moratorium on international trade and investment rules that restrict government responses to the crisis, in particular Investor-State Dispute Settlement (ISDS); renegotiation of WTO subsidies agreement and the WTO Agreement on Government Procurement (GPA), Agreement on Trade Related Investment Measures (TRIMS) etc.;
- 5) Environmental policies;
- 6) Monetary policies;
- 7) Public procurement policies (including defence policies).

Trade policies were concerned primarily with a reduction in trade barriers, intellectual property and copyright protection through trade treaties and sought explicitly to eliminate government intervention in markets. As such, reshoring is tied more closely to industrial policies emphasising technological change (e.g., integration of Industry 4.0), workforce training, organisational changes (e.g., JIT production), export advice, coordination and provision of information for local supply chain development, and integration supplemented by (national, regional and local) tax incentives and infrastructure/fixed capital provision. A re-focus on manufacturing (reshoring) policy gathered speed after the Financial Crisis and in response to the high rates of employment decline in the manufacturing sector in many OECD countries.

### 5.1 The United States of America

The US has experienced a loss of approximately 5 million manufacturing jobs since 2000 (Long, 2016). At least since the 2012 presidential election, the public debate regarding reshoring has been very active in the US. President Obama and presidential candidate Mitt Romney both blamed offshoring to China for the weakening manufacturing sector in the US (Kinkel, Pegoraro and Coates, 2020). In office, President Obama followed up on this campaign rhetoric with a range of policies aimed at discouraging offshoring and benefiting the creation of new manufacturing jobs in the US. A few examples include tax incentives for firms producing in the US or the support of synergies between research centres, universities, and the

private sector (The White House, 2012a).<sup>56</sup> The signature initiative of the administration was the establishment of 'Manufacturing USA',<sup>57</sup> a network of 14 public-private research institutes, each focusing on a different advanced manufacturing technology to further the goal of securing America's future in advanced manufacturing. Obama also highlighted the private platform 'Reshoring Initiative',<sup>58</sup> where successful cases of reshoring are made public and firms can find support resources when considering moving production back to the US. While there have been a few notable cases of reshoring in the US between 2009 and 2015<sup>59</sup>, this phenomenon could hardly be considered widespread (Oldenski, 2015). Many US firms still engaged in offshoring, sometimes simultaneously to reshoring activities. This is unsurprising, as reshoring might make sense for one specific production line but not for another (ibid.).

While the Trump administration did not share many of the social and economic policies of the Obama administration, both have claimed to prioritise strengthening the domestic manufacturing sector and bringing back jobs from overseas. However, while the Obama administration focused on fostering the competitiveness of US manufacturers through R&D and innovation policies, the Trump administration put more emphasis on cutting costs (Piatanesi and Arauzo-Carod, 2019). Notable policies included a 2017 tax cut for firms that reduced corporate income tax from 35% to 21% and decreased taxes for repatriation of overseas funds to incentivise bringing back profits from foreign subsidiaries (Chernova and Chernova, 2020; Kinkel, Pegoraro and Coates, 2020). Moreover, the Trump administration lowered legal standards for environmental protection aimed at decreasing costs for producing firms (Piatanesi and Arauzo-Carod, 2019). In 2017 and 2018, Trump enacted policies that were increasingly protectionist and often targeted allies (such as Canada and the EU) as well as rival countries like China. The administration introduced tariffs on imports of aluminium, steel, washing machines, and solar panels as well as a range of products from China, accelerating a trade war between the two countries.<sup>60</sup> Typically, tariffs were justified on the basis of national security concerns, leverage for future trade agreement negotiations or support for domestic manufacturing.<sup>61</sup> The Trump administration repeatedly claimed that foreign countries would pay for those import tariffs. However, research suggests that while tariffs might have helped industries that are in direct competition with imported products affected by tariffs, the major share of the costs of tariffs will have been passed on to downstream companies and domestic consumers (Amiti, Redding and Weinstein, 2019). The Trump administration negotiated two major trade agreements: the US-Mexico-Canada Agreement (in force July 1, 2020) and the 'Phase One' deal with China (in effect from February 14, 2020). Arguably, tariffs imposed on imports shaped the negotiations and led to a certain willingness to negotiate by Mexico, Canada and China. Nevertheless, the trade deals were strongly criticised. The USMCA overall fails to address longstanding trade issues between the US and Mexico but introduces innovative labour provisions that

<sup>56</sup> The following quote exemplifies the importance domestic manufacturing had already acquired in the Obama administration. *"I don't want America to be a nation that's primarily known for financial speculation and racking up debt buying stuff from other nations. I want us to be known for making and selling products all over the world stamped with three proud words: 'Made in America'. And we can make that happen."* — Statement by President Obama at the Insourcing American Jobs Forum, January 11, 2012 (The White House, 2012b)

<sup>57</sup> See <https://www.manufacturingusa.com/about-us> (26.11.2020)

<sup>58</sup> See <https://reshorennow.org/> (26.11.2020)

<sup>59</sup> For example, General Electric moved production of water heaters from China to Louisville, Kentucky, in 2009. Caterpillar opened a new plant to produce excavators in Victoria, Texas, in 2012 (Oldenski, 2015).

<sup>60</sup> Tariffs on steel and aluminium were also targeted towards allied countries or regions (Canada, EU). Chinese goods worth more than USD 200 billion fall under various tariff schemes introduced by the Trump administration. See e.g., <https://taxfoundation.org/tariffs-trump-trade-war/>, [https://www.washingtonpost.com/opinions/the-real-results-of-trumps-trade-tariffs/2020/11/01/90f67fe0-1944-11eb-82db-60b15c874105\\_story.html](https://www.washingtonpost.com/opinions/the-real-results-of-trumps-trade-tariffs/2020/11/01/90f67fe0-1944-11eb-82db-60b15c874105_story.html) (26.11.2020)

<sup>61</sup> National security concerns were given as reasons for steel and aluminium tariffs. Moreover, the administration has argued that technology competition with China also justifies as a national security threat and introduced tariffs on Chinese goods and restrictions against particular companies such as Huawei and TikTok on these grounds. See <https://www.brookings.edu/policy2020/votervital/did-trumps-tariffs-benefit-american-workers-and-national-security/> (26.11.2020)

aim at levelling the playing field in terms of workers' rights and wages.<sup>62</sup> Other than that, the USMCA is essentially very similar to the North American Free Trade Area (NAFTA) (Scott, 2020). The deal with China contains tariff cuts for Chinese goods in exchange for the promise of Chinese imports of American farm, energy, and manufactured goods as well as a more stringent approach to intellectual property protection by the authorities (Reuters, 2020). Critics argued that the deal neither addresses core issues concerning trade with China, such as alleged currency manipulations and systematic labour rights violations, nor does it deal with questions of whether China will meet the purchases agreed upon (Craymer and DeBarros, 2020).

The US has seen more reshoring in recent years than other high-wage countries and regions, such as the EU (Chernova and Chernova, 2020). The Reshoring Initiative claims that more than 900 000 manufacturing jobs have been brought back to the US from abroad since 2010 and up to the first half of 2020.<sup>63</sup> 2017 marked a peak in reshoring with about 190 000 jobs announced (reshoring plus FDI), followed by a slight decline in job growth through reshoring in 2018 and 2019. It is important to keep in mind that these figures, although purporting to account for the employment effects of reshoring, actually include both jobs generated by FDI and those kept from offshoring (KFO). Several key push and pull factors have been shown to facilitate reshoring in the US (Kinkel, Pegoraro and Coates, 2020). According to Kinkel, Pegoraro and Coates (2020), the most important push factors (i.e., factors that discourage manufacturing offshore) are (i) loss of know-how and intellectual property theft; (ii) reduction of labour cost gaps; and (iii) total cost of sourcing, transportation cost or cost of control. Pull factors that facilitate the (re)location of manufacturing in the US include: (i) low energy costs; (ii) investment in automation technology (additive manufacturing, robotics, advanced machine tools); (iii) vicinity of production to R&D; (iv) relaxation of environmental regulation; and finally (v) lower corporate tax rates.

While firms reshored their production to the US, the overall number of production plants has decreased every year since 1998 (Scott, 2020).<sup>64</sup> Nonetheless, a general positive trend in overall manufacturing employment has been observed, with about 166 000 additional jobs per year from 2010 to 2019. However, the COVID-19 crisis has wiped out many (manufacturing) jobs since early 2020. Manufacturing employment decreased by about 700 000 from March to August 2020, a massive number compared to the approximately 500 000 additional manufacturing jobs the US added from March 2016 to March 2020.<sup>65</sup> The large number of job losses may be partially blamed on the general mishandling of the pandemic by the Trump administration (Scott, 2020). Nonetheless, the COVID-19 crisis could start an accelerated trend towards more reshoring, especially if policy support increases in the coming years. If firms react to the crisis that revealed weaknesses within the GVC model by localising their value chains, production will be brought back to the domestic market. Data for the first half of 2020 show an uptick in reshoring job announcements: about 70 000 were published, compared to respective data for the full year of 2019 of around 50 000.<sup>66</sup> A notable case that might be considered reshoring is the announced construction of a semiconductor fabrication plant in Arizona by Taiwanese market leader TSMC.<sup>67</sup> In November 2020, the TSMC board approved setting up a wholly-owned subsidiary in Arizona with USD 3.5 billion in capital, which is part of an expected USD 12 billion investment in total. Construction of the modern chip factory is expected to

<sup>62</sup> For details, see e.g. <https://crsreports.congress.gov/product/pdf/IF/IF11308> (29.01.2021)

<sup>63</sup> See <https://reshorennow.org/recent-data/> (26.11.2020)

<sup>64</sup> 2018 is the latest year available, see <https://www.epi.org/publication/reshoring-manufacturing-jobs/> (26.11.2020)

<sup>65</sup> See the U.S. Bureau of Labor Statistics, <https://www.bls.gov/iag/tgs/iag31-33.htm> (26.11.2020)

<sup>66</sup> See <https://reshorennow.org/recent-data/> (26.11.2020)

<sup>67</sup> Regarding the case of TSMC's plan to build a production plant in Arizona, see amongst others, <https://www.forbes.com/sites/willyshih/2020/05/15/tsmcs-announcement-of-a-us-fab-is-big-news/>, <https://www.supplychainedive.com/news/tsmc-arizona-semiconductor-taiwan/579926/>, <https://www.reuters.com/article/us-tsmc-arizona/phoenix-okays-development-deal-with-tsmc-for-12-billion-chip-factory-idUKKBN27Y30E> (26.11.2020)

commence in 2021 and produce the first high-tech semiconductors from 2024. It aims to employ more than 1 600 workers. TSMC is the world's largest contract IC manufacturer and technology leader. The Taiwanese company is a critical supplier of US companies such as Apple, Qualcomm, Nvidia, AMD, and Intel. Therefore, its decision to locate close to US buyers (who are also located in or close to Arizona), should prove beneficial for the US semiconductor industry. While the US is said to provide substantial subsidies to TSMC, and while the planned production site will be small compared to Taiwanese sites run by TSMC, the deal can still be considered a major win for the Trump administration.<sup>68</sup> The ongoing trade war with China is said to have contributed to TSMC's decision to locate their plant in the US, aiming to forego possible trade restrictions when supplying US semiconductor companies.

In March 2020, President Trump signed the Coronavirus Aid, Relief, and Economic Security Act (known as CARES Act), a USD 2 trillion stimulus package aimed at mitigating the effect of the COVID-19 pandemic on the US economy.<sup>69</sup> This relief fund included several forms of assistance for different recipients (e.g., individuals, educational institutions, small, medium and large businesses). Manufacturers were eligible to apply for programmes that totalled around USD 1 trillion for all businesses. These programmes included several support instruments such as loans (partly forgivable), tax and labour provisions.<sup>70</sup> This support was very much needed for the battered manufacturing sector and contributed to a rebound of production after the initial shock in March and April.<sup>71</sup> However, the funds provided by the CARES Act have been almost entirely used up and political banter has so far hindered a second stimulus package (Mutikani, 2020). In August 2020, Trump issued an executive order instructing the federal government to favour drugs and medical supplies made in the US.<sup>72</sup> According to industry representatives, this order was hastily put together, was not helpful, and may have disrupted the global pharmaceutical supply chain (PhRMA, 2020). One of Trump's main campaign slogans was 'Buy American'. However, the lack of concrete policy related to reshoring meant that 'Buy American' was not effective (Lee, 2020).

President Biden is going to continue the effort to strengthen the manufacturing sector, including offering support to bring offshored jobs back to the US, although his approach to facilitating manufacturing and reshoring will differ. His campaign focused on climate change and ways to mitigate it. He promised to re-enter the Paris Climate Agreement and return to a more cooperative trade policy, bringing the US back to the world's table (Harvey, 2020). Before taking office, Biden's team revealed plans to redirect USD 400 billion in procurement by the federal government to US-made goods and to formulate stricter requirements for the label 'Made in America'. Moreover, the team announced plans to a change in tax codes, which should dis-incentivise offshoring, especially in strategically relevant sectors such as the pharmaceutical industry (Cosgrove, 2020). If the measures announced are implemented, there will be a stronger focus on investment in R&D, innovation and strategic investment in identified core/strategic sectors coupled with skill policies than there had been under his predecessors.<sup>73</sup> In his first days in office, President Biden declared the re-entry to the Paris Climate Agreement and signed a number of executive

<sup>68</sup> The city of Phoenix (Arizona) has agreed to provide critical infrastructure for the production plant, federal subsidies are — to our knowledge — still under negotiation. TSMC expect to receive substantial subsidies to cover the additional costs of locating in the US. See e.g., <https://www.reuters.com/article/us-tsmc-arizona/phoenix-okays-development-deal-with-tsmc-for-12-billion-chip-factory-idUKKBN27Y30E> (26.11.2020)

<sup>69</sup> See e.g., <https://home.treasury.gov/policy-issues/cares>, <https://www.bdo.com/insights/industries/manufacturing-distribution/coronavirus-aid-relief-and-economic-security-act> (26.11.2020)

<sup>70</sup> For details see <https://www.bdo.com/insights/industries/manufacturing-distribution/coronavirus-aid-relief-and-economic-security-act> (26.11.2020)

<sup>71</sup> See e.g., <https://fred.stlouisfed.org/series/IPMAN> (26.11.2020)

<sup>72</sup> See <https://www.whitehouse.gov/presidential-actions/executive-order-ensuring-essential-medicines-medical-countermeasures-critical-inputs-made-united-states/> (26.11.2020)

<sup>73</sup> See <https://joebiden.com/made-in-america/> (26.11.2020)

orders putting climate change on top of his agenda and reversing orders signed by President Trump.<sup>74</sup> Related to off- and reshoring, Biden signed an executive order changing policies and practises of the federal procurement of services, goods, products or materials, giving preference to those with US origin.<sup>75</sup> Whether president Biden will be more successful than Trump in his effort to bring back manufacturing capacity, remains to be seen.

Overall, while anecdotal evidence suggests that some manufacturing jobs have been reshored, any gains were offset by further offshoring of jobs until 2018, in part, because of a stronger dollar (Scott, 2020), with some indication that the Trump trade war with China resulted in a decline in the offshoring index in 2019 (A.T. Kearney, 2020).

## 5.2 The United Kingdom

The global financial crisis of 2008 triggered a public debate in the UK regarding the feasibility and best method to 'rebalance' the economy towards greater sustainability in the future (Bailey and Tomlinson, 2017). As a consequence, the neo-liberal model of industrial policy — where the State played a limited role and the emphasis was on free market, privatisations etc. — that had dominated UK policymaking since the late 1970s, gave way to a more interventionist approach (ibid.). High debt levels, reduced manufacturing capacity, negative trade balances and growing regional inequalities added urgency to this debate (Wade, 2009; Hutton and Lee, 2012; Foresight, 2013; UKTI, 2014). Notable early initiatives to strengthen the manufacturing sector after the global financial crisis included forming and supporting institutions, which aspired to develop appropriate policy instruments by bringing together the expertise of politicians, industry representatives and other actors. An example of such an initiative within the automotive industry is the 'Automotive Council', a collaborative institution linking the government, the Original Equipment Manufacturers (OEM) and research centres as well as universities (Bailey and Tomlinson, 2017). In this instance, the Council recognised the UK car industry supply chain's relative competitiveness and identified approximately GBP 4 billion in potential orders that car manufactures were interested in placing in the UK (Automotive Council, 2015).

Another government initiative to strengthen local manufacturing supply chains was the 'Advanced Manufacturing Supply Chain Initiative' (AMSCI), a GBP 345 million national programme launched in 2012 to support the global competitiveness of the advanced manufacturing supply chain (mainly automotive and aerospace) as well as to retain high-value manufacturing in the UK.<sup>76</sup> The programme was designed as a funding competition among firms: funds were available to support skills training, R&D, and capital investment and were intended to support UK supply chains in achieving high standards as well as encourage new suppliers to locate production in the UK. The initiative was very popular among suppliers and was considered highly successful in supporting local supply chains, although the relatively high minimum funding level of GBP 2 million per project in the early rounds disadvantaged small and medium-sized enterprises (Bailey and Tomlinson, 2017). Later rounds (AMSCI-WMLCR), which allocated funds amounting to GBP 25 million, focused only on the automotive and aerospace industry in the West Midlands and the Liverpool City Region. The minimum funding level was reduced to GBP 100 000 and the programme thus proved more accessible to Small and Medium Enterprises (SMEs). In 2014, the Liberal Democrat / Conservative coalition launched the 'Reshoring UK' initiative, an organisation to further develop pre-established trade associations and sector organisations (currently around 26).<sup>77</sup> The initiative

<sup>74</sup> See <https://www.whitehouse.gov/briefing-room/statements-releases/2021/01/27/fact-sheet-president-biden-takes-executive-actions-to-tackle-the-climate-crisis-at-home-and-abroad-create-jobs-and-restore-scientific-integrity-across-federal-government/> (01.02.2021)

<sup>75</sup> See <https://www.govinfo.gov/content/pkg/FR-2021-01-28/pdf/2021-02038.pdf> (01.02.2021)

<sup>76</sup> See e.g., a description of the programme by the European Commission: <https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/support-measure/advanced-manufacturing-supply-chain-initiative> (27.11.2020)

<sup>77</sup> See <https://www.reshoring.uk/>

has since offered various forms of support, ranging from providing expert advice to developing a business case for reshoring production and financial support for SMEs (de Backer et al., 2016). In order to support small UK-based suppliers, Reshoring UK also connects large manufacturing companies (e.g., OEMs) with local suppliers. This key service permits large companies to deal with smaller enterprises, which were previously excluded from their business network.

Key policy documents identify crucial strategic sectors for industrial and innovation policy (Foresight, 2013; UKTI, 2014) in order to channel funds into those sectors and technologies. These policies mainly include competitive funds for firms, research institutions, and universities but also to local enterprise partnerships (LEPs). By 2017, those strategic sectors/technologies were replaced by four societal grand challenges (AI and Data Economy; Clean Growth; Future of Mobility; Ageing Society) in the White Paper on Industrial Strategy (HM Government, 2017). These grand challenges are broken down into individual missions, concrete targets or achievable steps towards a grand challenge that contextualises projects (Mazzucato and Dibb, 2019). A competition for different missions within the grand challenges took place and funding was allocated to concrete projects.<sup>78</sup> This particular national policy mirrors the Horizon Europe programme at the EU level (Mazzucato, 2018).<sup>79</sup>

Since 2016, Brexit has dominated the political agenda. Up until late December 2020, the chance of a deal between the UK and the EU to regulate seamless cross-border trade was considered highly unlikely.<sup>80</sup> This fundamental uncertainty about future trading conditions presented major challenges for UK-based companies that rely on international supply chains. Luxury car manufacturer Bentley, owned by Volkswagen, but with production facilities located in Crewe, Cheshire, implemented risk mitigation measures by chartering cargo planes to ship parts in case of delays at seaports in an attempt to avoid any potential supply disruptions in early 2021. In addition to this expensive and unusual form of shipping, Bentley has also been stockpiling parts for up to two weeks of production, up from their usual two days' worth of production.<sup>81</sup> The concerns surrounding Brexit in business and the scientific community are not new. While, compared to Germany and France, the UK was always less integrated within the EU single market, EU member countries still provided 9.3 % of UK's intermediate inputs in 2014, of which 16.3 % stemmed from the manufacturing sector (Ijtsma et al., 2018). Over the last two decades, the EU has become a less important destination for exports, partly due to the increasing share of direct service exports of the UK (ibid.; Ward, 2020). However, the EU still accounted for 47 % of the UK's total trade, providing 52 % of its imports, and receiving 43 % of its exports in 2019 (Ward, 2020). Even though Brexit, and possible future issues regarding the relationship with the EU, are certainly going to be a test for the UK economy, there is the possibility that the changed situation might lead to an increase in both domestic manufacturing and reshoring, with manufacturers seeking to eliminate the risk of future tariffs or possible supply chain disruptions (Bailey and Tomlinson, 2017; Vanchan, Mulhall and Bryson, 2018; Kinkel, Pegoraro and Coates, 2020). Recent congestion at the port of Southampton illustrates the challenges ahead.<sup>82</sup>

Once the cradle of the first industrial revolution, the UK's manufacturing industry has in recent decades lost a large share of its old dominance. In 1990, the entire manufacturing sector contributed around 17 % of value-added to the UK economy and then declined sharply until 2009, at which point it began to stabilise at around, or slightly below, 10%.<sup>83</sup> Despite the decline, the UK is still the ninth largest manufacturing nation, accounting for around GBP 191 billion in sales per year and providing 2.7 million jobs, with average

<sup>78</sup> See <https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/missions> (26.11.2020)

<sup>79</sup> See [https://www.ffq.at/sites/default/files/downloads/page/mazzucato\\_report\\_2018.pdf](https://www.ffq.at/sites/default/files/downloads/page/mazzucato_report_2018.pdf) (26.11.2020)

<sup>80</sup> See e.g., <https://www.theguardian.com/politics/2020/nov/16/brexit-what-happens-to-the-uk-on-31-december-deal-or-no-deal> (27.11.2020)

<sup>81</sup> See <https://www.theguardian.com/business/2020/dec/02/bentley-books-planes-to-bring-in-parts-in-event-of-no-deal-brexit> (03.12.2020)

<sup>82</sup> See <https://www.bbc.com/news/business-55230469> (09.12.2020)

<sup>83</sup> See data by the World Bank, <https://data.worldbank.org/indicator/NV.IND.MANF.ZS?locations=GB> (27.11.2020)

manufacturing wages 13 % higher than the overall average wage in the UK (Make UK, 2020c). Comprehensive data on reshoring activity is scarce, as it is not provided by authorities. Kinkel et al. (2020) gathered multiple reports and articles to estimate the share of companies that engaged in reshoring in a two-year time period across European countries and found that 3.3 % of all UK companies were actively engaged in reshoring activities, slightly below the 4.0 % average of selected European countries. The overall sentiment of businesses towards reshoring seemed to be positive in recent years, as illustrated in a survey by Lloyds Bank, where 37 % of surveyed manufacturing firms claimed to be planning to move previously offshored processes back to the UK (Lloyds Bank, 2019). Despite recent political and public support for reshoring, Make UK (2020a) found that only 21 % of surveyed UK manufacturers have *moderately* increased their use of UK-based suppliers over the past two years, and none report to have *significantly* increased their local supplier base.<sup>84</sup>

Like many countries across the world, the UK was hit hard by the COVID-19 pandemic. Besides the tragic consequences of a major public health crisis, the UK economy reported a massive contraction of around 25 % in monthly GDP and approximately 30 % in monthly manufacturing output from February 2020 to April 2020 (ONS, 2020). The economy rebounded shortly thereafter with high growth rates for some months (e.g., 9.1 % GDP growth rate in June 2020), but recovery slowed once again in late summer, and September GDP remained 8.2 % below February levels (*ibid.*). Production values in the manufacturing sector in September 2020 were about 8.1 % below production values in February 2020 (*ibid.*). Pharmaceutical, grain mill products, textiles and electrical equipment manufacturers in the UK experienced growth in output from the start of the pandemic, while the manufacture of motor vehicles and aircraft and related sectors suffered the largest production contraction, with 20 % to 30 % lower production in September, compared to February 2020 (*ibid.*).

In March 2020, the National Health Service (NHS) called on manufacturers to produce up to 22 000 medical ventilators in a matter of weeks. This wartime-style effort was called the 'Ventilator Challenge'.<sup>85</sup> Although the programme was less successful than anticipated, as many ventilators were faulty or not up to medical standards (Davies, 2020), the fact that automotive and aerospace manufacturers such as Rolls-Royce, Airbus, Ford, McLaren and their respective supply chains managed to reorganise production to manufacture medical ventilators in a matter of weeks, was interpreted as testament of the strength of the UK's manufacturing sector. The spokesperson of Reshoring UK, Julia Moore, highlighted that the Ventilator Challenge revealed that the UK still has a wide range of high-quality suppliers, but that large OEMs were sometimes not even aware of them (Machinery, 2020). Commentators believe that these recent experiences, in combination with Brexit and a weak pound, will lead to increased reshoring in the immediate future (Machinery, 2020; Make UK, 2020a).

### 5.3 Japan

In an effort to jumpstart the sluggish economy of Japan in decades prior, Shinzo Abe started his second term in office as Prime Minister of Japan in 2012 with an emphasis on economic policy. These policies, referred to as 'Abenomics', aimed to revitalise the Japanese economy via three broad sets of measures (dubbed the three 'arrows'). The first consisted of inflationary monetary policies in an effort to avoid deflation and support companies' competitiveness in export markets. The second 'arrow' denoted fiscal policies in the form of government spending programmes to stimulate demand and consumption in the short-term and to stabilise public debt in the medium to long term. The third set of measures included a number of structural reforms whose objective was to increase the competitiveness of Japanese industries

<sup>84</sup> Previously EEF The Manufacturers' Organisation, Make UK represents businesses in the engineering, manufacturing and technology-based sectors and lobbies government, regional development agencies as well as European institutions on behalf of its clients. See <https://www.makeuk.org/about> (05.12.2020)

<sup>85</sup> See <https://www.ventilatorchallengeuk.com/> (05.12.2020)

and encourage investment into the private sector. A major part of this third 'arrow' was the negotiation of the 'Trans-Pacific Partnership' (TPP) with major trading partner countries, later continued without the US under the name 'Comprehensive and Progressive Agreement for Trans-Pacific Partnership' (CPTPP). While an overall assessment of 'Abenomics' is complicated due to the multitude of different policy instruments enacted within the program, it can be seen as somewhat successful, as it arguably contributed to GDP and output growth and a moderate inflation rate (see, e.g., OECD, 2017; Ito et al., 2018).

The Bank of Japan was successful in its attempt to devalue the Yen.<sup>86</sup> However, despite the weak Yen, widespread reshoring of Japanese companies, a goal of Abe's inflationary monetary policy, was not accomplished.<sup>87</sup> Nevertheless, some notable companies including Honda Motors, Casio Computers, and Canon (among others) have deemed it both feasible and economically beneficial to reshore production back to Japan (Pidchosa and Buz, 2020).

China is undoubtedly Japan's most important trading partner. Between 2000 and 2018, Japan increased the share of exports to China from around 6.3 % to 19.5 %. Conversely, the dependence on Chinese imports increased from 14.5 % in 2000 to 23.2 % in 2018, peaking in 2016.<sup>88</sup> Since the 1980s, Japanese companies have continued to expand their supply chains to China. Low labour costs were the main reasons for early offshoring, but proximity to the Chinese market of more than 1 billion people became an increasingly important motive during later stages (Dharish and Simran, 2020). Historically, the relationship between Japan and China has often been difficult, although relations between the two countries had recently appeared to improve as Prime Minister Abe met Chinese President Xi Jinping in China in late 2019 and extended an invitation to another meeting in Japan in the Spring of 2020 (Kyodo, 2019).

The COVID-19 pandemic may have further changed the situation. As with other trading nations, Japan had to acknowledge in February 2020 that its economy may have been excessively reliant on critical goods produced in China (Kuo, 2020). As companies experienced supply chain disruptions, the Japanese government aimed to create some economic distance with China through a COVID relief fund, whilst also cancelling the planned state visit of Xi Jinping. In April 2020 the government approved a stimulus package worth JPY 108.2 trillion (USD 993 billion), approximately equal to 20 % of Japan's GDP. As part of this relief fund, Abe designated JPY 220 billion (USD 2.1 billion) to companies deciding to move supply chains back to Japan from China and a smaller amount JPY 23.5 billion (USD 220 million) to support diversification away from China into ASEAN countries<sup>89</sup> (Dharish and Simran, 2020). This explicit policy to economically disengage from China and facilitate reshoring attracted significant international attention (see, e.g., Reynolds and Urabe, 2020).

In recent years, Japanese companies have started to diversify their geographical portfolios as a result of lower labour and energy costs in ASEAN countries as well as political tension and trade policies related to the US-China trade war (Dharish and Simran, 2020). The number of Japanese company affiliates in China peaked between 2012 and 2015 and has been declining ever since (ibid.). Given its proximity to China, openness to foreign investment, pro-business government, and low energy costs, Vietnam has emerged as a favourite target country for manufacturers (Takeo and Jamrisko, 2020).

The reshoring policy of the Japanese government attracted keen interest on the part of companies early on. At the end of the first round of applications in June 2020, the Japanese Ministry of Economy, Trade and

<sup>86</sup> See yahoo finance: <https://finance.yahoo.com/quote/JPY=X?p=JPY=X&tsrc=fin-srch> and <https://finance.yahoo.com/quote/CNYJPY=X/> (06.12.2020)

<sup>87</sup> As, for example, demonstrated by the decision of Toyota in 2015 to spend USD 1.4 billion on building new factories in Mexico and China, not betting on Japan as a production location. <https://www.japantimes.co.jp/opinion/2015/04/19/commentary/japan-commentary/toyota-delivers-blow-abes-reshoring-plan/> (06.12.2020)

<sup>88</sup> 2018 is the most recent year available. See UN Comtrade data: <https://wits.worldbank.org/countrysnapshot/en/JPN/textview> (06.12.2020)

<sup>89</sup> These include Brunei, Cambodia, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand and Vietnam.

Industry (METI) announced they would assist in shifting operations of 57 companies, including privately-owned facemask-maker Iris Oyama Inc and Sharp Corp, to Japan. METI spent about USD 536 million on firms moving production back to Japan and invested USD 114 million to support 30 additional companies in relocating to ASEAN countries (Bloomberg News, 2020; Dharish and Simran, 2020; Takeo and Jamrisko, 2020). It is worth noting that the second round of subsidies, which closed in July 2020, saw applications totalling eleven times the allotted budget (Akiyama, 2020). During the second round, Japan added India and Bangladesh as target locations for nearshoring (TBS Report, 2020). It seems likely that the strong policy support to reshore production to Japan or to diversify in the region will hasten the trend of Japanese firms moving out of China (Kuo, 2020; Takeo and Jamrisko, 2020). Still, a complete decoupling from China, which would be politically and economically unfeasible, remains unrealistic. China will remain a key trading partner of the area, but a 'China plus one' supply chain management approach could be the model of the future (Patchett, 2020).

## 5.4 Conclusion

The review of the three case study countries reveals different profiles of policy approaches towards reshoring (see Table 5). With the exception of Japan allocating a small share (about 0.2%) of the COVID-19 relief fund to directly supporting reshoring of Japanese manufacturing capacity from China, support from the US and UK for reshoring has been rather indirect, i.e., through measures that raise the innovative capacity and productivity of domestic establishments and production systems which, in turn, may encourage reshoring, nearshoring, FDI inflows, or domestic firm creation.

The most widespread vehicles utilised to increase manufacturing output and employment shares are a mix of innovation and industrial policies, which boost innovation and productivity of national and regional production systems. Strong innovative activities, tacit knowledge creation, administrative support, targeted public investment in infrastructure, research facilities and worker training schemes raise the attractiveness of investment and/or may tempt firms to reshore their productive capacities. These policies are expected to yield particularly high returns if they are linked to grand challenges and mission-oriented innovation (Mazzucato and Dibb, 2019) and tied to regional smart specialisation strategies.<sup>90</sup> In contrast to strong post-war intervention in industrial and innovation policies through its Ministry of International Trade and Industry (MITI), Japan appears to be less inclined to invest and coordinate industrial activity at the current economic juncture, preferring to focus on financial incentives and on increasing the competitiveness of its private sector.

In addition to innovation and industrial policies, trade, monetary, and security policies have also been introduced by the US and Japan. Monetary policies to lower the value of the Japanese Yen were favoured by Japanese policymakers, while US policymakers focused on policies regarding trade. The introduction of quotas, an increase in trade tariffs, stricter enforcement of copyright or patent infringements, and the increase in import duties as compensation for (perceived) dumping only appear to be relevant for the US. However, with the exception of a few individual success stories, research is inconclusive regarding the success of Trump's trade war with China, whose aim was to create manufacturing jobs through reshoring or FDI (A.T. Kearney, 2020; Scott, 2020). In part, this may also be explained through the unfavourable exchange rate of the USD (Scott, 2020) and the lack of sufficiently skilled labour to allow widespread reshoring activities. The Biden administration hints at continuing the strict enforcement of intellectual property theft (patents, copyright) and anti-dumping measures, but is unlikely to maintain higher trade tariffs on selected industries imposed under Trump's presidency.<sup>91</sup>

<sup>90</sup> See e.g., <https://s3platform.jrc.ec.europa.eu/what-is-smart-specialisation-> (12.12.2020)

<sup>91</sup> See <https://joebiden.com/made-in-america/> (26.11.2020)

In all three countries, gains in manufacturing employment since 2012 were unable to compensate for the extraordinary losses in manufacturing jobs sustained during the financial crisis, and any such gains were wiped out by the current pandemic. Considering the uncertainty with the ongoing COVID-19 crisis, the UK's new and emerging relationship with the EU, and possible continuing geopolitical tensions between the US and China, it is impossible to judge whether reshoring success stories remain isolated cases or are signs of a broader, future trend. The UK manufacturing sector may either benefit from reshoring or stand to lose as a result of the restructuring of EU supply chains. The effectiveness of policies aimed at strengthening domestic manufacturing by the Biden administration will likely depend on (economic) relations with China.

**Table 5:** Identified national policy measures that may affect reshoring (from 2012)

	US			UK	Japan
	Obama	Trump	Biden		
<b>1. Financial incentives:</b>					
Subsidies		*			*
Tax incentives	*	*	*	*	*
Loans		*	*	*	
Public Procurement		*	*		
Land and Infrastructure Provision / investment	*		*	*	*
<b>2. Innovation policies:</b>					
Mission-oriented				*	
Technological upgrading / investment			*	*	
Research centres / university synergies	*		*	*	
Upskilling of workforce	*	*	*	*	
<b>3. Industrial policies:</b>					
Identification of Grand challenges				*	
Strategic sectors	*		*	*	
Industrial clusters / smart spec.				*	
<b>4. Trade policies:</b>					
Anti-dumping / countervailing duty orders	*	*	*		
Tariffs / quotas		*			
Patent / copyright enforcement	*	*	*		
<b>5. Environmental policies:</b>					
Lower energy cost	*	*			*
Lower tax on energy use					
Lower environmental standards		*			
<b>6. Monetary Policy</b>					*
<b>7. Defence Policy</b>		*			

Source: own elaboration

Notes: \* mentioned substantially in various policy documents; Economic policies are listed separately for three US administrations in order to highlight continuities and breaks.

## 6 Conclusions and Policy Recommendations

In this final section, we will (i) summarise key findings derived from the analysis provided in this report, and (ii) suggest a number of key policy recommendations with respect to the employment of reshoring policies in the EU.

### 6.1 Key findings

The **number of exogenous shocks upon GVCs** due to natural disasters, pandemics, political conflicts as well as cyberattacks **will likely increase in the future**. As global value chains are exposed to a growing number of shocks, promoting their resilience will become a major concern for lead firms. Where supply chains produce critical products for human safety, public health and national security, governments as well as the EU institutions, as the guarantors of last resort for the security of supply with such products, will become challenged to develop effective policies to this end.

**High expectations for reshoring due to economic factors and digital technologies are unrealistic.** Prevailing expectations about large-scale reshoring to the EU due to economic and technological factors, in particular digital technologies, are likely unrealistic in the short to medium term. The limited evidence available so far suggests only a weak trend towards reshoring to the EU pre-COVID-19, due, for example, to automation and additive manufacturing, or because of quality issues and the importance of proximity to market. While the proliferation of specific digital technologies such as Industry 4.0 applications, automation and additive manufacturing might trigger some reshoring, ICT technologies will arguably increase firm's capacities to manage offshored and outsourced production networks. The same holds true for other economic factors. While, in the future, proximity to market might become more important in certain industries for a variety of reasons (e.g., consumer preferences, flexibility in production, etc.) and wage cost differentials become less important for production location decisions, other factors such as high sunk costs, and the growing importance of emerging economies as consumer markets will make the aggregate impact of digital technologies on reshoring rather subdued.

**A decisive future reshoring factor will be geopolitics.** A decisive factor determining the future international division of labour, and thus of reshoring, relates to geopolitical developments as well. The systemic rivalry between the US and China might promote the unbundling and duplication of strategic value chains within the context of regionalisation processes, through which both countries try to secure their technological sovereignty and leadership. The central issue for the EU will be how it positions itself in this context. Will the EU strive to create a third pole oriented towards maintaining constructive relations with both the US and China, while at the same time increasing its strategic autonomy so as to avoid pronounced political and economic dependencies? Or will the EU become exposed to the competing claims of the strategic rivals, with the likely consequence of political disintegration and economic fragmentation, as different EU member states are increasingly drawn into the sphere of influence of one of the rivals? Reshoring will play a role in both trajectories. In the first trajectory, the EU would have a strategic interest in promoting relatively integrated GVCs led by EU firms that dispose of shorter and more regionalised value chains, extending both to neighbouring regions like Eastern Europe and Northern Africa. In this context, nearshoring would provide an opportunity for diversifying supply chains by establishing alternative production locations in addition to existing suppliers located particularly in Asia. The implementation of such a nearshoring strategy would however depend on partner countries' willingness to cooperate in the relocation of production. This would in turn need to be supported by regulatory alignment at least in those sectors in partner countries, for which nearshoring is explicitly aimed at. Experience with regulatory alignment to EU standards in the past suggests that institutional capacities in partner countries will need to be strengthened to this end. In the second case, EU led-GVCs would become more integrated with GVCs led by US and Chinese lead firms, respectively.

The **green transition** in response to the climate crisis **will likely lead to shorter and more regionalized value chains**. With respect to the green transition in response to the climate crisis, planned EU policies to give a price to environmental externalities, harmonise national regulatory regimes and promote the circular economy will make offshored/outsourced production more costly, and thus provide an incentive for shortening GVCs, including through backshoring and nearshoring. The effects on reshoring will of course depend on the design of such policies, for instance, the sectoral coverage, the methodologies applied for monetising ecological damages, or the degree and speed of regulatory harmonisation. Reshoring will arguably play a more important role at the interface between green transition policies and geopolitics. To the extent that multilateral solutions to environmental problems are not forthcoming, the EU and other countries aiming at environmental leadership may resort to unilateral policies. Thus, countries might use trade policy instruments such as border adjustments both for environmental reasons and for promoting strategic autonomy. Other countries will likely interpret this as protectionism in disguise and retaliate. Either way, international trade will likely become more expensive and cumbersome, which will deter offshoring and outsourcing and promote reshoring processes.

**Multilateral approaches to secure the free flow of trade in critical products are likely to fail.** Historical experience, including during the COVID-19 pandemic, suggests that during emergency situations, governments will resort to imposing export restrictions to safeguard domestic supply with critical goods. In our view, it is futile to promote multilateral approaches with the aim of securing the free flow of critical goods during crisis situations by banning the imposition of export restrictions for defined goods. There is simply no legal mechanism available at the international level that could force governments to abstain from using this policy option. In legal terms, such a binding obligation would be potentially incompatible with the exceptions granted under existing WTO safeguard provisions. According to Art XX GATT, countries are permitted to suspend trade commitments necessary to protect public morals as well as human, animal or plant life or health. The national security exception of Art XXI GATT grants even more policy space to countries. Even if it were possible to establish such a multilateral arrangement, its efficacy would be severely limited, and it would infer a high political opportunity cost upon the parties that pressure other governments into such an agreement.

## 6.2 Key policy recommendations

**If reshoring is employed, it should be one amongst several instruments available to promote specific policy objectives:** Depending on the specific objective, the contribution of reshoring needs to be carefully addressed. In the case of the EU, the study has identified two economic policy objectives of particular relevance, against which the role of reshoring should be explicitly assessed: (i) increasing the **security of supply with critical products** for human health and safety, in particular pharmaceuticals and medical products, against the background of the increasing frequency of natural and man-made threats; and (ii) safeguarding and **expanding the technological sovereignty of the EU economy in the quest for greater strategic autonomy in a changing international order, which includes the grand societal challenge of the green transition** as outlined in the European Green Deal. With respect to both policy objectives, reshoring will be only one among several policy instruments.

**Reshoring and related policies need to be tailored to the specific characteristics of the GVC under consideration:** Given the diversity and highly specific nature of GVCs, even amongst those within the same sector, **no general policy approach to reshoring exists**. It should also be noted that the success of the policies for promoting reshoring as applied in other countries such as the US, the UK and Japan, has been limited. Thus, it is critical that the policies applied and the respective role that reshoring plays in these policies are adjusted to the specific characteristics of the GVC under consideration, given the overarching policy goal to be achieved. Thus, as illustrated in the case study on pharmaceuticals, reshoring might arguably be a necessary component of a strategy to improve the security of supply with selected APIs for

the production of specific generic drugs deemed critical to public health in emergency situations; in other cases, expanding obligations to increase the resilience of supply chains or stockpiling FDFs or APIs necessary for the production of other generic drugs might be preferable. Such tailor-made and case-specific policies will need comprehensive screening processes involving academic experts, public regulators, industry representatives and experts from civil society organisations.

Reshoring can be **promoted directly by sector-specific policies and indirectly by horizontal policies**. Sector-specific, direct policies include obligations for companies to source domestically or use domestic production or financial incentives to reshore production. Horizontal, indirect policies include measures that make international trade and transport more expensive, such as carbon taxes, preferential tariff rates for nearshored products, or due diligence obligations for lead firms to increase the resilience and robustness of their supply chains.

Though established to serve other primary policy objectives, **horizontal policies can potentially make a substantial contribution to reshoring**. Environmental policies that correct for market failures in international trade, such as carbon taxes, border tax adjustments, or international harmonisation of environmental and social standards will contribute to an alignment of social costs with private costs of production, and thus reduce the rationale for offshoring and outsourcing that is not warranted from a social and environmental perspective. Since this contributes to the geographical diversification of production, it will also play a part in increasing security of supply.

**As another horizontal policy, public procurement could be used to promote security of supply by preferential sourcing** from suppliers that (i) commit to due diligence requirements to increase the resilience and robustness of their supply chains, and/or (ii) commit to using domestic production capacities and sourcing from regional suppliers, respectively. There is a legal debate on the flexibilities provided for by existing public procurement law with respect to promoting security of supply considerations. Madner et al. (2020) argue that EU procurement law and European Court of Justice (ECJ) jurisprudence allow for stipulating due diligence requirements in public tendering procedures; the same, however, does not apply to regional and national preferences and sourcing quotas, as the latter would discriminate suppliers from other members states. It would, however, be possible to introduce a preference for sourcing from companies residing in structurally disadvantaged regions across the EU. The question of whether a preference can be introduced for producers residing in the EU or disposing of production capacities in the EU has to be assessed against the EU's commitments under the GPA of the WTO. The GPA rules apply to procurement activities for governmental purposes by covered entities and relate to covered goods and services above specified threshold values. The threshold for the procurement of goods by central government contracting authorities is EUR 139 000 (EU Annex 1), whereas the relevant threshold for procurement by sub-central government entities is EUR 214 000 (EU Annex 2). In the case of the EU, sub-central government entities include all regional and local contracting authorities as well as bodies governed by public law (as defined in the EU procurement directive). Thus, although the choice of domestic over foreign goods would principally be inconsistent with the general non-discrimination principle, preference given to local products below the thresholds would be possible. Whether this also applies to procurement acts above the defined thresholds is doubtful, although the GPA provision on security and general exceptions (Art. III) stipulates that parties may take measures that are necessary to protect (a) public morals, order or safety, and (b) human, animal or plant life, or health. These measures must not, however, be applied in a manner that would constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on trade. According to established standards of WTO law interpretation, the provisions of Art. III thus relate to transitory periods such as emergency situations, and cannot form the basis of a long-term practice of discriminating foreign suppliers in favour of EU suppliers.

The **promotion of reshoring through financial incentives granted to companies**, in particular subsidies and tax incentives, should only be employed on condition that **a solid case has been established either**

**with respect to the strategic importance or to the criticality for security of supply of the sector or product under consideration** and that no other equally efficient and less-burdensome policy option is available. EU competition law however sets quite restrictive conditions to state aid. Thus it would have to be assessed, whether exceptions stipulated by the Treaty, such as, for example, Article 107(3)(b) of the Treaty on the Functioning of the European Union (TFEU) on important projects of common European interest (IPCEIs) or to remedy a serious disturbance in the economy of a Member State, provide a legal basis for subsidising the reshoring of critical manufacturing capacities. With respect to security of supply, reshoring thus might be an element of a policy approach to support minimum domestic production capacities in the EU. In economic terms, the latter are warranted mainly for two reasons related to the security of supply: (i) to maintain supply during short-term supply shortages due to GVC interruptions and export restrictions imposed by other countries; and (ii) to be in a position to ramp up production capacities due to demand surges in crisis situations. This calls for policies both to sustain existing production capacities in the EU, and to build new or reshore limited production capacities for products, where domestic production capacities are lacking altogether, but are deemed critical. Given the importance of economies of scale in the production of many mass products and intermediary inputs in the pharmaceutical and medical product GVCs, national policies will be inefficient and costly. In most cases, the economic viability of reshoring of production will necessitate EU-level coordination so as to establish economically efficient production capacities able to serve the entire EU market at low unit costs and maintain competitiveness with similar imported products.

**Stockpiling policies should be used as a complement to reshoring.** Stockpiling is often considered an alternative to reshoring, particularly by trade economists, who, out of efficiency considerations, favour stockpiling critical products instead of reshoring production (see, e.g., Baldwin and Evenett, 2020; Felbermayr and Görg, 2020). In contrast, EU industry representatives (e.g., Joachimsen, 2020) and sector consultants (e.g., Hosseini and Baur, 2020) argue in favour of promoting domestic production capacities, accompanied by reformed procurement policies in the EU, which allow public health agents to pay a premium for high-quality local production. Given the limited scope of our knowledge surrounding public health crises, i.e., the difficulty of knowing in advance which pharmaceuticals and medical devices will be needed in any given crisis, stockpiling is considered a complex and expensive option. Also, as the durability of most pharmaceuticals is limited, management burdens for pharmaceutical producers and traders would be severe and require substantial public subsidies in order for stockpiling to be economically viable, while its contribution to security of supply may prove to be limited. The extensive use of stockpiling policies should thus be restricted to cases where no EU manufacturing exists and the development of domestic manufacturing capacities is excessively costly. The manufacturing of examination gloves might be a case in point, given the very high economies of scale involved and the lack of local availability of the principal raw material required. In terms of implementation, stockpiling can be promoted by a variety of measures, including: (i) requiring producers and traders to maintain pre-defined stocks of critical products and/or intermediate products like APIs without any financial compensation; (ii) using public procurement to preferentially source from producers and traders that commit to minimum stockpiling obligations; (iii) handing out financial incentives to selected producers and traders who commit to maintaining defined stocks of critical products, e.g., potentially via an adapted Services of General Economic Interest (SGEI) model, as stipulated in Art. 14 TFEU; and finally (iv) through the establishment of public stocks of critical products managed by a public authority.

**A differentiated approach to employing trade policy for reshoring should be developed, essentially composed of three elements:** (i) Tariff policies will prove of limited effectiveness for promoting reshoring. The US has to date been the only country to employ tariff policies to promote reshoring, albeit with limited success. What is more, tariff increases incur an economic cost both on businesses and consumers. To have an impact on the investment decisions of companies and thus induce reshoring, such measures must be maintained for a considerable period of time. (ii) Targeted export restrictions and investment control

systems are instead clearly preferable to secure technology sovereignty. In terms of securing specific technological advantages, an effective method would be to prohibit the sale of certain high tech goods to particular clients, and/or to introduce investment control policies that prevent the sale of strategic technologies and assets to systemic rivals. The EU should thus continue with its efforts to install a comprehensive and coordinated system of investment screening in all Member States. (iii) With respect to nearshoring, EU trade policy might support increased nearshoring by EU-based companies, particularly for products where security of supply concerns suggest a more regionally diversified supply chain and production conditions in neighbouring countries are favourable. A key aspect of such a policy would consist in incentivising trade partners in the Eastern and Southern neighbourhood to pursue regulatory approximation in sectors of strategic interest, such as for instance pharmaceutical and medical intermediate products. To increase the effectiveness of regulatory approximation, the EU would need to actively support institutional capacity-building and technological upgrading in partner countries. Besides, the free flow of goods particularly during times of crisis would need to be contractually guaranteed. Given the widespread experience of countries employing export restrictions during crises, as again exemplified during the Covid-19 pandemic, such contractual arrangements would however need to be balanced, and also take the security of supply interests of partners into due account.

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